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(71) Demandeur/Applicant:
COGNOS INCORPORATED, CA

(72) Inventeurs/Inventors:
ADENDORFF, MICHAEL, CA;
ARMSTRONG, MICHAEL, CA

(74) Agent: GOWLING LAFLEUR HENDERSON LLP

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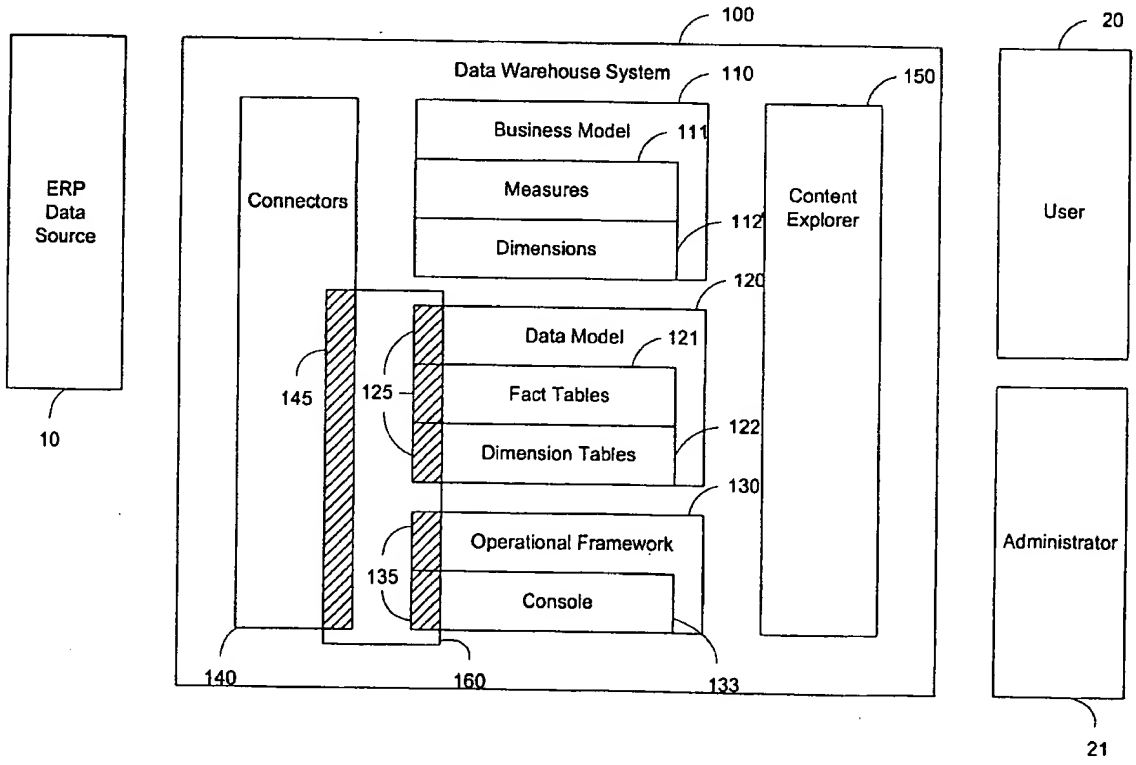


(57) Abrégé/Abstract:
A data warehouse system for managing performance of organizations is provided. The data warehouse system comprises a data model for storing data representing dimensions and measures applicable for multiple organizations, and a configuration unit for setting the placeholders such that the data model represents the particular organization. The data model has placeholders settable such that the data model represents a particular organization.

Abstract

A data warehouse system for managing performance of organizations is provided. The data warehouse system comprises a data model for storing data representing dimensions and measures applicable for multiple organizations, and a configuration unit for setting the placeholders such that the data model represents the particular organization. The data model has placeholders settable such that the data model represents a particular organization.

Data Warehouse System

FIELD OF THE INVENTION

This invention relates generally to business intelligence systems and in particular to an integrated data warehouse system.

BACKGROUND OF THE INVENTION

Many large organizations use enterprise resource planning (ERP) systems to consolidate day-to-day transaction data and streamline business functions such as manufacturing. With their predefined, standard reporting capabilities, however, these ERP systems are not optimized to support the flexible, *ad hoc* business analysis and reporting businesses need to make strategic decisions and improve business performance. Furthermore, ERP systems are not intended to serve as e-business analysis and reporting infrastructures.

For example, generating a report from an ERP system that shows product line sales by region by sales person for the past five years would typically be quite time-consuming. With their multitude of tables, fields, and column names, ERP systems are not well suited to end-user navigation. Without easy information access, and the means to quickly analyze and report on findings, users can overlook important business correlations or veer off-track completely. Ultimately, the quality and speed of decision-making suffer.

In addition, if hundreds or thousands of users were to submit queries directly, ERP system performance would be impacted, jeopardizing important production system functions. This, along with the risks associated with giving the extended e-business enterprise direct access to ERP systems, necessitates placing ERP data into an environment that is not only optimized for business analysis and reporting, but also for secure broad access. Seeking predictable performance and desiring to give users all the information they need quickly, many companies opt to build either data warehouses or data marts.

Companies which have strived to develop decision support systems that would support rich analysis and reporting realized that operational reporting systems (e.g., ERP systems) were limited in scope and the depth of insight they delivered. While

optimized for consolidating day-to-day transaction data and streamlining key business functions, these systems offer but a fraction of the reporting and analysis capabilities users need to fully comprehend what drives business performance.

Many companies turned to developing data warehouses to fill the requirement for consolidating data from across the organization, with a single consistent historical view, and designed for optimized reporting and analysis. The ultimate objective of these systems was to ensure that the data needed to answer the relevant business questions was captured and in a form that would support timely information for decision-making. While the intent was sound, the challenges of bringing together business and IT to define best practices from both a business and technical standpoint presented challenges. As a result projects failed resulting in decision makers being left without crucial information.

Created by extracting data from operational or transactional systems (like ERP sources) and e-commerce systems and installing it in a more analysis- and reporting-friendly database, data warehouses are repositories of data that support management decision-making. However, data warehouses are expensive to build and time consuming. (For example, they can take 18 to 24 months to create). Consequently, with enterprise information requirements evolving so fast today, data warehouses often fail to meet requirements when they are finally completed. Moreover, they require specialized skills and experience to build successfully.

Furthermore, due to their sheer scope, data warehouses seldom produce the finely tuned analysis and reporting that e-business decision-making depends upon. Intended to be all things to all people, these warehouses focus on breadth of content, rather than the depth of vital information sweet spots users need.

Unlike data warehouses that combine and make all corporate data available across an enterprise, data marts focus more narrowly, serving specific business areas or departments. Data marts also take less time and money to build and can therefore generate quicker payback than data warehouses.

Sound in principle, data mart creation can stumble in practice. While data marts can be built incrementally, they do not provide a holistic view of the enterprise. Companies will build a data mart for sales, another for inventory, another for finance, and so on. Unless these marts are coordinated, they act as stovepipes and prevent

users from sharing information across the enterprise. They also duplicate data and lead to lengthy updates because each mart must be refreshed individually. If companies update the marts at different times, even just a couple of hours apart, some users will have more current information than others. This lack of synchronization can lead to inconsistent analysis across the enterprise and cause users to question the integrity of the analysis and reporting solution.

For instance, users of one mart might define a "large" customer as one that generates more than $50,000 in revenue a month. Users of another might define a large customer as one that orders more than 100 units a month, which may only represent $10,000. In these cases, people can mistakenly think that they are discussing common ground. Not only may different marts define dimensions differently, they can calculate measures differently as well. For example, one department might compute "profit" by including bad debts and another may exclude them. These types of inconsistencies not only create misunderstandings, they can delay schedules and increase costs, jeopardizing customer satisfaction and profits.

There is a need for affordable data warehouse technology, which an enterprise can use to achieve and maintain a complete view of its operational and financial effectiveness, customer relationships, and supply-side activities.

SUMMARY OF THE INVENTION

The invention solves one or more of the above mentioned problems. In one embodiment of the invention, a configurable, integrated data warehouse system is provided. This integrated data warehouse system is rich and complete enough to be used by many organizations. The integrated data warehouse is also configurable to a particular organization. The initial steps of creating a data warehouse are manifested in this system. The configuration of the integrated data warehouse takes substantially less time to do than creating a data warehouse from scratch. Thus, time and expenses are saved with this invention.

The integrated data warehouse in another embodiment of this invention allows for an incremental building of the data warehouse. The system begins with a dimensional framework which represents an organization. Areas of analysis can then be added to the dimensional framework such that each area of analysis may be

compatible for cross-functional analysis. Thus, the incrementally created data warehouse allows for an integrated analysis of an organization's information.

In accordance with an aspect of the invention, a data warehouse system for managing performance of organizations is provided. The data warehouse system comprises a data model for storing data representing dimensions and measures applicable for multiple organizations, and a configuration unit for setting the placeholders such that the data model represents the particular organization. The data model has placeholders settable such that the data model represents a particular organization.

In accordance with another aspect of the invention, there is provided a method for configuring a data warehouse system. The method comprises steps of obtaining a data warehouse system comprising a data model for storing data representing dimensions and measures applicable for multiple organizations and a configuration unit for setting the placeholders such that the data model represents the particular organization, and using the configuration unit to set one or more data model placeholders in the data model of the data warehouse system. The data model has placeholders settable such that the data model represents a particular organization.

In accordance with another aspect of the invention, there is provided an operational framework for managing a data warehouse system. The operational framework comprises a console and a configuration unit. The console is used for configuring a data model in the data warehouse system to a particular organization and for configuring an extraction transformation loading tool to a particular data source system. The configuration unit includes placeholders settable to specify the particular data source system.

In accordance with another aspect of the invention, there is provided a connector for extracting source data from multiple data source systems and transforming the data for loading into placeholders in a data model. The connector comprises a configuration ETL code unit for extracting values from a data source system to set the placeholders in the data model and the operational framework, and a parameterized ETL code unit for using the values to extract information from the data source system, transform the data and load the data into the data model.

In accordance with another aspect of the invention, there is provided a dimensional framework for use as a foundation of a data warehouse system. The dimensional framework comprises a set of dimensions representing business reference aspects of multiple organizations. A subset of the set of dimensions represents the business reference aspects of a particular organization. The dimensions have placeholders settable set such that the dimensional framework represents the particular organization.

In accordance with another aspect of the invention, there is provided a method of providing a data warehouse for managing performance of organizations. The method comprises steps of providing placeholders in a data model and providing a configuration unit for setting the placeholders such that the data model represents the particular organization. The data model is used for storing data representing dimensions and measures applicable for multiple organizations. The placeholders are settable such that the data model represents a particular organization.

In accordance with another aspect of the invention, there is provided a method of providing a dimensional framework for use as a foundation of a data warehouse system. The method comprises steps of providing placeholders in a set of dimensions and providing a configuration unit for setting the placeholders such that the dimensional framework represents the particular organization. The dimensions represent business reference aspects of multiple organizations. A subset of the set of dimensions represent the business reference aspects of a particular organization.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a diagram showing a component overview of a data warehouse system;

Figure 2 is a diagram showing the configurable aspects of a data warehouse system;

Figure 3 is a diagram showing a component view of the configuration environment of a data warehouse system;

Figure 4 is a diagram showing a configuration view of a data warehouse system;

Figure 5 is a screen shot of an example of a set of configuration placeholders of a data warehouse system;

Figure 6 is a flow diagram showing the steps to configure a data warehouse system;

Figure 7 is a component view of a configuration unit of a data warehouse system;

Figure 8 is a flow diagram showing steps to configure a data warehouse system;

Figure 9 is a diagram showing the structure of an example of a business model of a data warehouse system;

Figure 10 is an abstract model of a business model of a data warehouse system;

Figure 11 is a diagram showing an example of a business model of a data warehouse system;

Figure 12 is a diagram showing another example of a business model of a data warehouse system;

Figure 13 is a diagram showing an example of supply-side performance management of a data warehouse system;

Figure 14 is a diagram showing an example of demand-side performance management of a data warehouse system;

Figure 15 is a diagram showing an example of financial performance management of a data warehouse system;

Figure 16 is a diagram showing an example of a data model of a data warehouse system;

Figures 17A to 17AE are diagrams showing examples of star schemas of areas of analysis of a data model of a data warehouse system;

Figure 18 is a screen shot of a data warehouse system console;

Figure 19 is another screen shot of a data warehouse system console.

Figure 20 is a diagram showing a screen-shot of financial analysis in a data warehouse application;

Figure 21 is a diagram showing a screen-shot of sales analysis in a data warehouse application;

Figure 22 is a diagram showing a screen-shot of inventory analysis in a data warehouse application;

Figure 23 is a screen shot illustrating a step of generating a report in a data warehouse system;

Figure 24 is a screen shot illustrating another step of generating a report in a data warehouse system;

Figure 25 is a screen shot illustrating another step of generating a report in a data warehouse system;

Figure 26 is s flow chart showing the creation of a business model of a data warehouse system; and

Figures 27A to 27E are flow charts showing the creation of a data warehouse system.

DETAILED DESCRIPTION OF THE EMBODIMENTS

In this description, the term business will be used to denote both commercial affairs and organizational affairs. The term data warehouse system will be used to denote a system implemented for the measurement and management of the performance of an organization. The organization may be commercial or non-commercial. A data warehouse system will include a data warehouse that is rich and complete enough to be applicable to many organizations and configurable to a specific organization. Finally, the term data warehouse system also relates to a business performance management system, including a business model and a query engine tool. The term business model in a data warehouse system relate to a business performance management model in a business performance management system. The term business performance management refers to the measurement and management of the performance of an organization.

Referring to Figure 1, a configurable data warehouse is described. Figure 1 shows a data warehouse environment including an enterprise resource planner (ERP) data source 10, a user 20, an administrator 21, and a configurable data warehouse system 100. The user 20 refers to the role of accessing the data warehouse system.

The administrator 21 refers to the role of administering the data warehouse system. These roles may be performed by the same person.

The configurable data warehouse system 100 includes a business model 110, a data model 120, an operational framework 130, connectors 140 and a content explorer 150. The business model 110 includes measures 111 and dimensions 112. The data model 120 includes fact tables 121 and dimension tables 122. The operational framework 130 includes a console 133.

The configurable data warehouse system 100 is a system for measuring the performance of an organization. The data warehouse system 100 may be applicable to various organizations and is not limited to only one organization. The data warehouse system 100 is configurable to a specific organization. Preferably, the configuration occurs after the installation of the system software and before the operation of the system software. Re-configuration may occur at any time thereafter.

The business model 110 includes the set of analytics and paths used to measure the performance of an organization. The business model 110 contains measures 111 which map the business questions to which users 20 of a data warehouse may want answers. The measures 111 represent measurements of business activity aspects of an organization. For example, a business activity may be a sales order. A measure 111 for a sales order may be sales order volume. Another example of a measure 111 is inventory amounts. In this example, inventory is the business activity measured.

Numerous business questions for numerous businesses are categorized into different areas of analysis. The set of measures 111 in the business model 110 represents a union of measures used to perform analysis for different organizations. Preferably, this union of measures comprises the minimum set of measures 111 needed to perform the desired analysis for all of the different organizations to which the business model 110 applies. I.e., although not all organizations may requires each measure 111 available in the business model 110, the measures 111 they do require will be available. The business model 110 also includes a set of dimensions 112 which represent the structure of an organization from an informational or dimensional viewpoint. I.e., the dimensions represent the business reference aspects of an

organization. An example of a dimension is the class of customers of an organization. Further examples of dimensions and measures are provided below.

The business model 110 is implemented in the data model 120. The data model 120 is organized to facilitate the analysis performed at the business model 110 level. The data model 120 contains fact tables which contain the measures used to measure the performance of an organization. The data model 120 also includes a set of dimension tables 122 which represents the structure of an organization from a dimensional viewpoint. Another example of a dimension is the class of employees of an organization.

Raw data information is collected from the organization ERP 10 and passed into the data model 120 through the connectors 140. One way to build the connectors 140 is through an extraction, transformation and loading (ETL) tool. The data warehouse system 100 is operated by an administrator 21 through the console 133 of the operational framework 130. The operational framework 130 is also used to configure the data warehouse system 100. Finally, the content explorer 150 contains a set of reports used by the user 20 to review the analysis performed by the data warehouse system 100.

As has been stated above, the data warehouse system 100 is designed to work for many different types of organizations and is configurable to a specific organization. Preferably, the configuration of the data warehouse system 100 occurs after the installation of the system software and before the operation of the system software. Configurability of the data warehouse system 100 is achieved by providing placeholders or parameters in various components of the system such that these placeholders or parameters are set during the configuration of the system software.

Referring to Figure 2, the configuration 160 of the data warehouse system 100 is described. There are configurable aspects to the data model 120, the operational framework 130, and the connectors 140. These configurable aspects are labeled on Figure 2 as 125, 135 and 145, respectively.

In Figure 3, the configuration 160 is enlarged. The configuration 160 occurs when the operational framework configurable aspects 135 interacts with placeholders located in the data model configurable aspects 125 and the connectors configurable

aspects 145. These placeholders are set with data from an organization ERP 10, preferably during the data warehouse system 100 configuration.

The connectors 140 contain ETL code, each connector having a set of codes which perform a certain function. The ETL code functions involve the extraction of data from the ERP 10 and the loading of the data into the data model 120. The connectors may be configurable to allow the data warehouse system 100 to operate with different operational system, resource system, etc. The console 133, may provide the administrator 21 with a set of questions or queries. The answer to these queries will define the configuration options in the ETL 145. The console 133 may also prompt an administrator 21 to specify values for the placeholders in the data model 120.

Referring to Figure 4, a configuration view 160 of an integrated data warehouse system 100 is shown in more detail. Figure 4 shows the configurable aspects of the data model 125, the configurable aspect of the operational framework referred to as the configuration unit 135, and the configurable aspects of the connectors 145. The configurable aspects of the data model 125 includes data model placeholders 126. These placeholders 126 represent information that is completed in the data model 120 during configuration. The configuration unit 135 includes the configurable portion of the console 133 and operational framework placeholders 136. These placeholders 136 are stored in a set of operational tables in the operational framework 130. The configurable aspects of the connectors 145 includes configuration ETL code 146 and parameterized ETL code 147. The configuration ETL 146 code may be used to extract values from the ERP 10 to set the placeholders. The parameterized ETL 147 code may then use the values of these placeholders 136 to extract information for the data warehouse system that reflects the configuration for the specific organization.

The configuration process involves setting the placeholders 126 and 136. There are two main methods to set the placeholders. One method involves providing the administrator 21 with options during the configuration. The administrator 21 may specify values to options listed in the console 133 that represent the characteristics of the organization that will have its performance measured by the data warehouse system 100. Figure 5 shows a screen shot of an example of a set of a set of

configuration placeholders of a data warehouse system 100. A second method involves obtaining the information used to set the placeholders directly from the organization ERP 10. To achieve this, the configuration unit 135 creates a job that extracts the desired information from the organization ERP 10 and loads it into the appropriate placeholder 126 or 136. Once the place holders are set, the data warehouse system 100 may operate.

Referring to Figure 6, a flowchart for configuring a configurable data warehouse system 100 is shown. The first step (501) involves installing the data warehouse system 100 software. Once the system software is installed, the administrator 21 may configure the system based on the ERP 10 environment (502). Once the administrative selections are made, the connectors 140 may access the ERP 10 and extract the desired information from the ERP 10. This information is loaded into placeholders in the data warehouse system 100 (503). Once the information is loaded, the data warehouse system 100 is ready to be used (504).

The configuration process 500 may be iterative. The administrator 21 may initially choose to do steps 501 through 504 in sequence. However, at each step in the process new values for the placeholders may be set. Thus, re-configuration of the data warehouse system may be performed by the administrator 21.

Referring to Figure 7, a component view of an embodiment of a configuration unit 135 is shown. Figure 7 represents an example of the information which may be set with the configuration unit 135. The configuration unit 135 includes a fiscal pattern settor 303, a currency settor 304, a user defined category selector 305, a multiplier settor 306, a source details selector 307, and an environmental settor 308.

The configuration unit 135 may provide means to configure the fiscal patterns to use in the data warehouse system 100. The fiscal pattern settor 303 may be used to set one or more fiscal patterns that reflect one or more fiscal calendars in use for an organization. Fiscal patterns reflect the fiscal reporting requirements of the organization. A fiscal pattern includes the number of periods, the first period in the fiscal year and the start date of each period. They are determined for an organization by accounting practices.

A placeholder 136 in the configuration unit 135 may be set to represent the identifiers of the fiscal patterns in the ERP data source 10. The administrator 21 may

set these placeholders. A configuration ETL 146 job uses the information stored in the placeholders 136 to extract this information from the ERP data source system 10 and load the information into the fiscal variant placeholders 126 in the date dimension of data model 125.

Another aspect of the configuration unit is the currency settor. Many organizations have transactions in many currencies. For analysis purposes, it is desirable for all amounts to be in the same currency. To support cross-functional analysis, the currency settor 304 may be used to set a currency to use for amounts subject to analysis. This configuration allows a user to specify a currency to be used for analysis. Amounts not in this currency may be converted into this currency. Thus, one aspect of the business model 110 is the notion of a common currency. This is represented in the data model 120 by amounts that have been converted to the proper currency. Within the operational framework 130 and the configuration unit 135, common currency is represented by a currency to which fiscal amounts are converted in order to analyse the information in the data warehouse system 100. Common currency is also represented by a financial currency conversion table that determines the rate used to convert a transaction in one currency to the common currency.

The configuration unit 135 may provide a means to set the currencies to use in the data warehouse, the currency to use for reporting, and the conversion rates to use to convert to the reporting currency. A placeholder 136 in the configuration unit 135 is set to represent the currency to use for reporting. Additional placeholders 136 may be specified to represent the currencies to expect in the ERP data source 10. The administrator 21 may set these placeholders.

A configuration ETL code 146 job may use the information stored in the placeholder 136 to extract the required currency conversion rates for the currencies, and to load this information into the placeholders of the currency conversion table 126, which is part of the data model 125. The connectors 140 load information into the data warehouse by means of the parameterized ETL code 147. The parameterized ETL code 147 may use information of the reporting currency in the configuration unit placeholders 136 and the conversion rates in the configured data model 126 to convert the fiscal amount to the appropriate currency.

Another aspect of the configuration unit 135 is the user category settor 305. Many organizations attach organization specific classifiers to dimensions 112. For example, for one organization, the color of hair of a customer may be important. The configuration of user 20 specific categories allows such organization specific classifiers to be part of the dimensional framework. Such organization specific classifiers may be considered as placeholders in the ERP 10. When analyzing a dimension 112, it is desirable to use the same types of aspects across all of the different analysis that will be performed.

The user category settor 305 may be used to select one or more user defined categories in each dimension for analysis of an organization. The configuration unit 135 may provide a means to set the user categories that are to be used to analyse information in the data warehouse. Placeholders 136 in the configuration unit 135 are set to reflect the user categories from the ERP 10 that are of interest to the organization for the purposes of business performance management and the placeholder 126 in the data model 125 where the user category is to be placed. The parameterized ETL code 147 of the connector 140 uses the placeholders 136 to determine which user category to select from the source ERP and where to store the information in the data model 125 using the placeholders 126.

Another aspect of the configuration unit is the multiplier settor. The multiplier settor 306 may be used to set multipliers for use during transaction aggregation and rollups. Organizations may attach meaning to specific quantities. For instance, a transaction may be a credit or a debit. The configuration of multipliers allows an organization to attach different meanings to values in business transactions which are organization specific.

The configuration unit may provide a means to set multipliers that are used to aggregate and attach meaning to the amounts which are loaded into the data warehouse system 100. One aspect of the configurable data model 125 is the placeholders 126 which are used to specify the multipliers to use for business performance management by the organization. The values attached to these placeholders are unique to an organization. The configuration unit 135 may use a configuration ETL code 146 job to set the values of the placeholders 126 representing multipliers in the data model, based on default information in the ERP data source 10.

The administrator 21 through the console 133 component of the configuration unit 135 may then review and change the values (i.e., override the default values) of these placeholders in the data model 126 to reflect the organization's needs for business performance management.

Another aspect of the configuration unit 135 is the source details settor 307. In an organization each ERP data source 10 is configured to meet the operational needs of the organization. There may be more than one location in the ERP 10 to store information. For example the ERP 10 may represent the relationships between business entities such as customers in a separate relationships table or by direct reference from one customer to another customer. Similarly the ERP system 10 may store all information related to several business entities in a single source table, and user defined (configurable) codes are used to specify which objects represent which types of business entities. For example all business entities associated with an address may be stored in a single table with codes representing which addresses represent customers and which represent vendors. As another example all sales activity may be stored in a single table, but different types of sales activities (order, direct shipments, etc.) may be identified through specific codes.

When the connectors 140 load information from the ERP data source 10 into the data warehouse system 100 they should know what information to extract for the purposes of business performance management. The configuration unit 135 may provide a means to specify this information. Placeholders 136 in the configuration unit 135 are used to specify the ERP 10 specific values that are to be used to extract the appropriate information from the ERP 10. The administrator 21, through the console 133 may set the values of these placeholders 136 to represent the ERP data source 10 for the specific organization. When the data warehouse system 100 is loaded from the ERP data source 10, the parameterized ETL code 147 of the connectors 140 uses the placeholders 136 in the configuration unit 135 to extract the appropriate information.

There are other configuration 160 options that have not been mentioned. These configuration options involve ERP 10 specific issues such as: What is the date format? These options may also include physical implementation details such as the name of the library where these tables exist, etc. This class of configuration options is

referred to as the environmental configuration options. The environmental configuration settor 308 allows for the configuration of such options. The environmental configuration settor 308 may also be used to handle the hardware configuration, the operating system configuration, and the database configuration, i.e., how dates are stored for obtaining the date.

The configuration unit may provide a means to set various environmental placeholders. Placeholders 136 in the configuration unit 135 are used to represent the values of the environmental setting. The administrator 21 sets the placeholders 136 in the configuration unit 135 using the console 133. The parameterized ETL code 147 may then use this-information to reflect the environment in which the data warehouse system 100 is operating.

Referring to Figure 8, a flowchart for configuring a data warehouse system 100 is shown. Once the data warehouse system 100 software is ready to be configured (701), one or more fiscal patterns that reflects one or more fiscal calendars used by the specific organization may be set (702). A currency to use for all amounts in the dimensional framework may be set to support cross-functional analysis (703). One or more user defined categories in each dimension 112 may be selected for analysis (704). Multipliers may be set for use during transaction aggregation and rollups (705). Source details may be set to identify what information to extract from which ERP 10 (706). Environmental configuration options may be set (707). These steps may be performed in alternative order. Furthermore, steps may be re-performed by the administrator 21. Once these steps are completed, the data warehouse system 100 is ready to be used (708).

Dimensional Framework

Another aspect of an example of an embodiment of the invention relates to the fact that the data warehouse system 100 analyses and measures a complete organization environment. I.e., the data warehouse contains the dimensions, tables, entities, etc., to reflect any one of an identified group of organizations. This analysis and measurement is performed through the concept of a dimensional framework.

The dimensional framework manifests itself in the dimensions 112, in the dimension tables 122. The dimensions 112 of the business model 110 are a set of

business entities, components or dimensions, such as customers, suppliers, vendors, material, employees, time, organization, etc. These types of business entities or dimensions are commonly used to analyze a business or organization in a data warehouse. However, in the configurable data warehouse system 100, the set of dimensions may be applicable to many different organizations; rather than custom-built for one particular organization.

The dimension tables 122 of the data model 120 are connected to fact tables 121, preferably, in a star schema format. This allows the same dimension table 122 to be used to represent the same dimension 112 in any fact table 121 which uses that dimension 112.

The operational framework 130 allows for the handling of hierarchies in the dimensional framework. The dimensional framework has common ways of handling hierarchies. I.e., customers contained within higher customer groups, or materials contained within higher material groups. The handling of hierarchies allows for consistency for analysis in the dimensional framework. From a configuration point of view, the dimensional framework may include certain details or aspects of specific placeholders in the dimension tables that are in the data model 120.

In one example of an embodiment of the present invention, the set of dimensions 112 includes 39 dimensions: company consolidation 320, profit center 321, cost center 322, business area 323, GL budget version 324, chart of accounts 325, accounting document class 326, sales document class 327, movement document 328, material movement class 329, quotation activity document 331, purchase order activity document 332, requisition activity document 333, contract activity document 334, procurement document class 335, vendor 336, material 337, customer 338, employee 339, organization 340, plant 341, material storage 342, storage bin 343, shipping point 344, AR activity document 345, GL activity document 346, AP activity document 347, all time (time, fiscal) 348, unit of measure 349, financial currency conversion 350, unit of measure conversion 351, user category 352, flexi-dimension 353, forecast version 354, sales status 355, procurement status 356, release strategy 357, valuation 358, batch 359, and stock class 360. Dimensions 112 may be added or removed from this set of dimensions 112.

This set of dimensions 112 may be applicable as part of a dimensional framework to many organizations. These dimensions 112 may also be configured to a specific organization through the use of a configuration unit 135. As described above, the configuration unit 135 may include a fiscal pattern settor 303, a currency settor 304, a user category settor 305, a multiplier settor 306, a source details settor 307, and an environmental settor 308.

The dimensional framework may contain one or more dimensions contain one or more placeholders settable to reflect a fiscal pattern of the particular organization. The dimensional framework may contain one or more dimensions contain one or more placeholders settable to reflect a common currency used by the data warehouse system. The dimensional framework may contain one or more dimensions contain one or more placeholders settable to reflect one or more categories defined by a user, the categories used to analyze information in the data warehouse system. The dimensional framework may contain one or more dimensions contain one or more placeholders settable to reflect one or more multipliers used by the data warehouse system.

Providing a dimensional framework for use as a foundation of a data warehouse system may include one or more of the following steps:

- providing placeholders in a set of dimensions, the dimensions representing business reference aspects of multiple organizations, a subset of the set of dimensions representing a particular organization;
- providing a configuration unit for setting the placeholders such that the dimensional framework represents the particular organization;
- providing placeholders comprises the step of providing one or more placeholders in the dimensional framework to reflect a fiscal pattern of the particular organization;
- providing placeholders comprises the step of providing one or more placeholders in the dimensional framework to reflect a common currency used by the data warehouse system;
- providing placeholders comprises the step of providing one or more placeholders in the dimensional framework to reflect a

category defined by a user, the category used to analyze information in the data warehouse system; and

- providing placeholders comprises the step of aggregating amounts loaded into the dimensional framework..

Components of the Data Warehouse System

Components of the configurable data warehouse system 100 will now be described in further detail. Built upon an operational framework 130 and a robust production environment, the data warehouse system 100 helps decision-makers derive business value from their enterprise data. By using the data warehouse system 100, organizations receive a wide, cross-functional view of their ERP 10 and e-business data, which provides a strategic perspective on key performance indicators (KPIs). And they reduce implementation costs and effort, which accelerates time to results.

An aspect of the data warehouse system 100 also relates to the challenges that organizations face when implementing data warehouses and traditional "stove pipe" data marts. A solution is provided, i.e., the integrated data warehouse, which comprises a series of coordinated data marts. These coordinated data marts allow organizations to deliver value-laden enterprise-wide data warehouse solutions that are important to competitive advantage in the e-business economy.

One advantage of the data warehouse system 100 lies in the quality of its business content. It is the business content that gives end users the ability to answer complicated questions involving numerous business dimensions 112 and quickly gain the insight required to make strategic decisions. The basis of this content combines business intelligence expertise established by broad studies and best practices proven by experience, including strategies which have helped many of the world's leading companies generate maximum decision-making value from their data. This business content is reflected in the business model 110, as described below.

The Business Model 110

By using the data warehouse system 100 according to the embodiment of the present invention, users may answer in-depth questions such as: "Which customers in the western sales region have increased their purchases by more than 30 percent in the

past three years?" or "How much revenue did we generate from international sales of Product X last November?" These types of complex queries, involving time, geography, product lines, revenues, and other business variables, require that multiple dimensions and levels of detail be examined. The data warehouse system 100 allows users to make connections between these cross-functional variables, connections that will provide insight into what is driving the business.

The business model 110 is based on comprehensive information about the business questions that users 20 in functional areas of an organization face, including hundreds of function-specific questions common to business people in many industries. In other words, someone who manages a sales force for a pharmaceutical company will face many of the same business challenges as someone who manages a sales force at a textile company or a semiconductor company. These questions can also be the basis of the business measures, dimensions, and attributes. Business rules that govern how to derive measures such as "net profit margin" or "inventory balances", i.e., measures that do not appear in ERP systems 10 and should be created, are also established in the business model 110.

Based on how companies manage their workflows within each functional area, the business questions can be categorized as strategic, tactical, or operational. Information needs associated with each category are reflected in the business model 110. For example: What level of data granularity do users require? How much history do they need? Five years? Three years? How often do they need to refresh data? Do they have to know what happened yesterday to answer a given business question or can they wait until the end of the week?

The structure of the business model 110 is presented in Figure 9. The business model 110 is made up of multiple business functional areas 202 (e.g., sales, accounts receivable (AR), general ledger (GL), accounts payable (AP), procurement, inventory, e-commerce, etc.) and a set of dimensions 112 reflecting the business model 110 manifestation of the dimensional framework. As has been stated above, the data warehouse system 100 may assist in the management of the performance of many types of organizations, including, but not limited to, not-for-profit organizations, for-profit businesses, charities, governmental organizations, etc. Thus, the business

functional areas 202 include functional areas of organizations that are not necessarily commercial enterprises.

For the purpose of data warehouse analysis, each business functional area (or functional area) 202 is divided into areas of analysis 203. In an embodiment of the invention, there are over 30 areas of analysis, but this number may change as the business model 110 evolves. The content 204 of an area of analysis 203 may include the KPIs, measures, attributes that are used to support the business analysis that can be performed. The functional areas 202, the areas of analysis 203 and the KPIs, measures, dimensions and attributes 204 may be arranged as shown in Figure 9.

Analytical functions may be added to the set of dimensions 112 to provide the business performance management offered in the data warehouse system 100.

Referring to Figure 10, a business model 110 rich and complete enough to be applicable to many organizations is described. The business model 110 comprises a set of functional areas 202, a set of dimensions 112, and relation indicators 390 showing a relationship between the dimensions and the functional areas of analysis. A functional area 202 is a set of areas of analysis 203. Each area of analysis contains measures 111, and may use many dimensions 112. The individual dimensions are labeled D_1 to Dn. The notations m, and n refer to integers where m is greater than 0, n is greater than m. Thus, in this abstract representation of a business model 100 rich and complete enough to be used by many organizations, there are n dimensions. Similarly, the functional areas 202 are labeled A_1 to A_y. The notations x and y refer to integers where x is greater than 0, and y is greater than x. Thus, in this business model 100, there are y functional areas of analysis 202.

Not all dimensions 112 or areas of analysis 203 will necessarily be used by all organizations to which this model applies. However, all dimensions and areas of analysis are available for the organizations. Most organizations will use most of the dimensions 112. As has been stated above, the dimensions 112 are used by the measures 111 and areas of analysis 203. The differences between organizations may be reflected in the areas of analysis 203 selected by the organizations. These areas of analysis 203 may then use the appropriate dimensions 112 to answer business questions of the organization. An organization may use all of the dimensions 112 and/or all of the measures 111.

The abstract business model 110 in Figure 10 shows how it is possible for one model to encompass all the dimensions 112 and functional areas 202 necessary for a group of organizations. The more dimensions 112 and the more functional areas 202 added to the model, the richer and more complete the model will be, so as to allow for other organizations to use it. Having one business model 110 which is rich and complete enough to be used by multiple organizations is advantageous because the business model 110 only need to be built once and then configured to a particular organization.

Figure 11 shows an example of a business model 110. This business model 110 includes a set of dimensions 112 and six functional areas 202 including sales analysis 401, AR analysis 402, GL analysis 403, AP analysis 404, inventory analysis 405 and procurement analysis 406. The functional areas 202 are comprised of areas of analysis 203. The areas of analysis 203 are comprised of measures.

The area of analysis 203 of the sales analysis 401 functional area helps analyze sales raw data to increase sales. Companies may select from a host of key performance metrics and decision-ready reports that enable them to analyze forecast accuracy and pipeline volume, profile leads, calculate average deal size, and examine revenues and profitability. With the sales analysis 401 functional area, companies may:

- Evaluate discount practices, target customers who generate the highest margins, and spot clients who cost the most;
- Know about prospects, customers, and product performance; and
- Identify opportunities, increase revenues, minimize costs, and shorten the sales cycle.

The areas of analysis 203 of the sales analysis 401 functional area may include the following: sales functional performance analysis 410, customer sales analysis 411, product sales analysis 412, sales organizational effectiveness analysis 413, and shipping performance analysis 414. Other areas of analysis may be added, such as e-commerce analysis. In this example, this functional area relates to 100 business questions, 80 KPIs, 11 dimensions, and 43 reports.

The area of analysis 203 of the AR analysis 402 functional area helps analyze raw AR sub-ledger transaction level data to manage a corporate asset. The AR

analysis 402 functional area helps restructure AR data into key measurable facts used for strategic planning, program management and execution, and AR performance monitoring and reporting. Companies may select from a host of key performance metrics and decision-ready reports that enable them to continuously analyze the effectiveness of their AR function, performance of existing resources, and fully understand the existing customer base.

The areas of analysis 203 of the AR analysis 402 functional area may include the following: AR functional performance analysis 420, customer credit analysis 421, AR corporate self-appraisal analysis 422, AR cash inflow analysis 423, and AR organizational effectiveness analysis 424. Other areas of analysis may be added, such as quality of AR analysis. In this example, this functional area relates to 77 business questions, 71 KPIs, 12 dimensions, and 28 reports.

The areas of analysis 203 GL analysis 403 functional area helps analyze raw GL transaction level data to manage a corporate asset. The GL analysis 403 functional area helps restructure GL data into the key measurable facts used for strategic planning, program management and execution, and financial performance monitoring and reporting. Companies may select from a host of key performance metrics and decision-ready reports that enable them to continuously analyze their company's financial health.

The areas of analysis 203 of the GL analysis 403 functional area may include the following: financial performance reporting and analysis 430, budget analysis 431, key financial ratio reporting and analysis 432, and operational performance and analysis 433. Other areas of analysis may be added, such as sales functional performance. In this example, this functional area currently relates to 60 business questions, 50 KPIs, 11 dimensions, and 24 reports.

The areas of analysis 203 AP analysis 404 functional area helps analyze raw AP sub-ledger transaction level data to manage a corporate asset. The AP analysis 404 functional area helps restructure AP data into the measurable facts used for strategic planning, program management and execution, and AP performance monitoring and reporting. Companies may select from a host of key performance metrics and decision-ready reports that enable them to continuously analyze the

effectiveness of their AP function, performance of existing resources, and enhance understanding of the existing vendor base.

The areas of analysis 203 of the AP analysis 404 functional area may include the following: AP performance analysis 440, AP vendor account analysis 441, AP cash outflow analysis 442, and AP organizational effectiveness analysis 443. Other areas of analysis may be added. In this example, this functional area relates to 80 business questions, 64 KPIs, 12 dimensions, and 28 reports.

The areas of analysis 203 inventory analysis 405 functional area helps deliver value to managers by helping turn raw data into information used to take action. The inventory analysis 405 functional area helps provide a host of key performance metrics and decision-ready reports that enable companies to analyze forecast accuracy, stock levels and valuations, stock fluctuations (e.g., minimum and maximum stock levels, stock outs), and key inventory analytics (e.g., ABC analysis, inventory turns, and stock coverage).

The areas of analysis 203 of the inventory analysis 405 functional area may include the following: stock overview and valuation analysis 450, material movement activity analysis 451, demand analysis 452, material reservations analysis 453, physical inventory analysis 454, and inventory forecast analysis 455. Other areas of analysis may be added. In this example, this functional area relates to 150 business questions, 100 KPIs, 15 dimensions, and 49 reports.

The areas of analysis 203 of the procurement analysis 406 functional area helps deliver value to managers by turning raw data into the information used to take action. The procurement analysis 406 functional area helps provide a host of key performance metrics and decision-ready reports that enable users to analyze purchasing volumes and patterns across commodities, analyze performance of the buying organization, deliver vendor scorecarding, review comparative vendor performance, and assess operational effectiveness.

The areas of analysis 203 of the procurement analysis 406 functional area may include the following: material expenditure analysis 460, material demand analysis 461, procurement vendor analysis 462, procurement process effectiveness analysis 463, and procurement organizational effectiveness analysis 444. Other areas of analysis may be added, such as bill of material analysis, and e-procurement analysis.

In this example, this functional area relates to 180 business questions, 139 KPIs, 15 dimensions, and 35 reports.

Figure 12 shows a business model 110 where the dimensions are grouped according to the following groupings of dimensions 112: organizational dimensions for financial analysis 391, functional document dimensions 392, master dimensions 393, operational entity dimensions 394, financial transaction activity 395, universal dimensions 396, and functional specific dimensions 397.

The dimensions 112 are linked with the functional areas and areas of analysis for the purpose of reporting and analysis. For example, Figures 11 and 12 show that the sales analysis 401 uses the sales document class 327, material 336, customer 337, employee 338, organization 339, shipping point 342, all time (time, fiscal) 347, unit of measure 348, unit of measure conversion 350, and sales status 354 dimensions. Other functional areas of analysis may use different dimensions. The relationship between functional areas and dimensions are shown in Figures 11 and 12 by way of connecting lines 390.

The business model 110 is extensible and scalable: it may be expanded to include more functional areas, more areas of analysis and more KPIs, measures, dimensions and attributes. Other examples of business model functional areas 202 and their respective areas of analysis 203 include:

Human Resource Analysis

- Payroll Analysis
- Professional Development Analysis
- Recruiting Effectiveness Analysis

Financial Controlling Analysis

- Cost Analysis
- Profitability Analysis

Customer Relationship Intelligence

- Customer Profiling
- Customer Base Demographics
- Marketing Analysis
- Process Effectiveness Analysis

- Customer Satisfaction

Supply Chain Intelligence

- Vendor Scorecarding
- Demand Forecasting Analysis
- Process Effectiveness
- Inventory Status Analysis
- Procurement Activity Profiling

The set of dimensions 112 may also be used with a subset of functional areas 202 or areas of analysis 203 or with other functional areas of analysis. Such examples include cross-functional performance management, among others: supply-side performance management (see Figure 13), demand-side performance management (see Figure 14), and financial performance (or GL) management (see Figure 15). The business model 110 would itself also supports the above areas of cross-functional performance management, among others, including individual functional areas akin to a data mart.

Figure 13 shows an embodiment of supply-side performance management as containing the following functional areas 202: AP analysis 404, inventory analysis 405, and procurement analysis 406. The relevant areas of analysis 203 and dimensions 300 are also displayed in the format of the business model 110 as shown in Figure 11. Figure 14 shows an embodiment of demand-side performance management as containing the following functional areas 202: sales analysis 401, and AR analysis 402. The relevant areas of analysis 203 and dimensions 300 are also displayed in the format of the business model 110 as shown in Figure 11. Figure 15 shows an embodiment of financial performance management as containing: AR analysis 402, GL analysis 403, and AP analysis 404. The relevant areas of analysis 203 and dimensions 300 are also displayed in the format of the business model 110 as shown in Figure 11.

The business model 110 is extensible. As has been described, administrators 21 may add new functional area data marts to further enhance their enterprise analysis and reporting. Administrators 21 may broaden the source data collection points beyond the ERP 10 system to gain a more complete view of the enterprise and customer relationships. Components of the data warehouse system 100 are also

designed for high scalability. Organizations may also increase the number of users that the system supports, accommodating corporate expansion without the growing pains.

The areas of analysis in the business model 110 exemplified above may each be one of a series of pre-packaged data marts aimed at meeting the market demand for cross-functional business intelligence (BI) against data held within corporate ERP 10 systems and other sources of data within the enterprise. Each component contributes to the core functional information requirements of an enterprise, taking its place within the data warehouse system 100 "backbone" which is comprised of data marts targeting other core data including sales, distribution, billing, inventory, financial and cost accounting, and human resource management.

The sales analysis functional area 401, AR analysis functional area 402, GL analysis functional area 403, AP analysis functional area 404, inventory analysis functional area 405, procurement analysis functional area 406, and e-commerce analysis functional area questions listed above represent a sampling of the type of valuable information available in the respective analysis of the data warehouse system 100, information that business professionals desire to effectively manage their roles and responsibilities. The questions address the desire for information regarding the following:

- sales, shipping and billing portion of the sales cycle;
- demand for information regarding the organization's ability to meet collection expectations, customer profiling, and analyst performance;
- demand for information regarding the GL;
- demand for information regarding the organization's ability to meet payment expectations, vendor profiling, and analyst performance;
- demand for information regarding the investment in stock, process effectiveness, use of resources, and the effectiveness to meet the demand of internal and external customers;
- demand for information regarding the commodities purchased, vendor activity and performance, analysis of internal demand; and
- the demand for information regarding the e-commerce order taking process of the e-commerce cycle.

It should be noted that more analysis is possible. The multi-dimensional nature of the sales, AR, GL, AP, inventory, procurement and e-commerce analyses components, along with the power of business intelligence tools, offers robust analysis around any single question, further expanding the knowledge gained from the data extracted from the source ERP 10 system.

The Data Model 120

The following will describe an embodiment of this invention using a star schema. It should be noted that this invention is not limited to a star schema data model. The invention may be applied to other types of data models.

Figure 16 shows an embodiment of a data model 120. In this embodiment, the data model 120 implements the business model 110. The data model 120 includes a set of dimension tables 122 corresponding to the dimensions 112 of the business model, and fact tables 121 which are analogous to the functional areas 202 of the business model 110. The fact tables 121 may relate to a data mart, multiple data marts, or an integrated data warehouse. Furthermore, the configurable dimensional framework allows for more fact tables 121 to be added to the data model 120.

In this example, the fact tables are divided into six functional areas 202: sales analysis 901, AR analysis 902, GL analysis 903, AP analysis 904, inventory analysis 905 and procurement analysis 906. Figures 17A to 17AE show the individual star schemas for each individual areas of analysis 203 as reflected in the data model 120. The areas of analysis 203 of the functional areas 202 and their measures 111 are listed below.

The components of the data model 120 may be provided as part of a pre-packaged solution. Some components may be provided separately and integrated with other components of a data model 120. Each component of the data model 120 is designed from careful consideration of the dimensions 112 or measures 111 that are common to each functional area 202 of the business or organization. Based on common terms and common information, these dimensions 112 ensure that users in relevant departments approach business issues using the same references.

For example, the dimension "customer" 337 means precisely the same thing to a sales manager as it does to an inventory warehouse manager or a finance vice

president. Without conforming dimensions, each department would likely develop different definitions, hierarchies, terms, and dimensions for many of the same business measures, an inefficiency that can sidetrack productivity and hamper decision-making.

Incorporating common dimensions 112 means that IT builds the tables (121 and 122) only once, less redundancy because data is stored once, and shorter time to update because updated data is loaded once. Moreover, multiple star schemas can leverage the shared dimensions 112 to reduce update time and resources. For example, updates occur once for a change to a dimension table 112 that is shared by five fact tables 121, not five times, which speeds the update process. In addition, common dimensions save disk space, reduce redundancy, and ensure that data is consistent from one data mart, or functional area of analysis 203, to the next.

The data marts, or functional areas of analysis 203, perform business performance management faster than traditional ERP 10 systems which distribute data fields among thousands of tables. Finding the fields that describe a given query in an ERP 10 system often requires joining copious tables, a time-consuming step that slows analysis and drains database processing power. The data warehouse system 100 incorporates a star schema architecture that accelerates query performance and produces fast business insight for high-speed analysis and reporting.

Star schema architectures contain two types of tables: fact tables 121 and dimension tables 122. A fact table 121 comprises the transaction history associated with each activity being modeled. These fact tables 121 store the numerical measurements of the business and include an ID field for each dimension that they represent. For instance, a sales fact table 121 might include fields for Customer ID, Sales-person ID, Product ID, Quantity Sold, Discount, and Total Amount, etc. The fact tables 121 are linked to several dimension tables 122 that qualitatively describe the fact table 121 fields in more detail. For instance, the Salesperson ID dimension table might include Salesperson ID, Salesperson Name, Phone Number, Sales Office, and Employee Number, etc.

This star structure, with the fact tables 121 surrounded by satellite dimension tables 122, allows users to drill down quickly into the data to uncover correlations between dimensions 112 and elements in the fact table 121. Forming queries involves

a set of simple one-way joins, from the fact table 121 to each dimension 112, rather than complex multi-step joins through multiple levels of tables. Users 20 get the information they need quickly, allowing them to solve business problems, spot trends, or act on opportunities.

Traditional stovepipe data warehouse applications, such as traditional data marts, may serve certain departmental decision-making needs, but they fail to offer a variety of important enterprise-wide views. By incorporating common dimensions, the data model 120 allows knowledge workers to share information across departments and gain important decision-making synergies. Based on common terms and common information, common dimensions ensure that users in relevant departments or functional areas approach business issues using the same references.

To solve a business problem, sometimes decision-makers want to see transaction details, not just higher level summaries. For this reason, the components of the data warehouse system 100, which contain both relational and OLAP data, extract the most granular data from the source ERP 10 systems and use it to populate the data marts. Decision-makers may therefore access transaction-level detail and gain a micro view of the business issues at hand.

Offering detailed granularity takes pressure off the source ERP system 10 as well. Rather than query the production system every time they need to perform detailed analysis, decision makers may simply query the components of the data warehouse system 100 and glean the insight they desire.

One embodiment of the present invention provides a configurable dimensional framework to be used as a base for a data mart, multiple data marts, or an integrated data warehouse application 100, which offers the benefits of both data warehouses and data marts, i.e., the breadth of an enterprise-wide data warehouse and the luxury of incremental data mart implementation. This structure enables an organization to maximize the return on its ERP 10, e-commerce, and other source data system investments. Released from the analysis and reporting confines of ERP 10 systems, users 20 can now creatively explore business problems and make equally creative and effective business decisions.

Moreover, users may incrementally add data marts over time, expanding the integrated data warehouse system 100 at their own pace. Each new data mart fits

seamlessly with its predecessors, extending the scope of the data warehouse system 100 to produce effective cross-functional business content, e.g., the fundamental information users need to understand their business drivers.

For example, if the inventory turnover rate suddenly dropped, users would want to know why. With an integrated data warehouse system 100 comprised of several subject-specific data marts, users could explore whether the root of the problem lies in sales or in inventory, perhaps the result of a change in the company sales compensation plan or a tightening of credit policy. By sharing the same conforming dimensions 112 (for instance, "product") in both the sales and inventory marts, users could generate these types of revealing cross-functional views. The result: enterprise-wide decision-making is improved.

The Connectors 140

The business driven extractions and source-to-target mappings are labeled as connectors 140 on Figure 1. Business-driven extractions and source-to-target mappings incorporate business rules that unravel ERP systems 10 such as SAP R/3 (TM), Oracle Applications (TM), and J.D. Edwards (TM), and are open to alternative sources.

A complex part of building a traditional data mart involves extracting the right data from the source system, transforming it into the desired form, and loading it into the data marts. To facilitate and expedite this process, a repository is built for the data warehouse system 100 connectors 140. The connectors 140 understand both the source ERP system 10 and the targets. This repository uses business rules to transform data from the ERP system 10 to the targets.

The data warehouse system 100 simplifies the complex process of extracting data from specific source systems such as J.D. Edwards, SAP R/3, and Oracle, overcoming the technical hurdles and addressing the unique characteristics involved in each system.

Extracting data may involve in-depth knowledge about the underlying source system. Traditionally, developers of data warehousing needed to know where the relevant data comes from and what the specific data structures look like. They also needed to know about the technical hurdles specific to their source systems 10. The

data warehouse system 100 has functions to adapt to a variety of source systems. An embodiment is based on extensive experience with SAP, Oracle, and J.D. Edwards ERP systems 10. For example, SAP uses pooled and clustered table structures, Oracle provides "flex" fields, and J.D. Edwards maintains address books in a special way. Each system contains unique characteristics that affect data mart building. The data warehouse system 100 addresses these source features. This inherent source system intelligence of the data warehouse system 100 spares users 20 from having to spend time analyzing complex ERP and e-business systems.

In addition to speeding the extraction process, the connectors 140 incorporate safeguards to protect data integrity. As data comes across from the source system 10, the connectors 140 look for specific conditions. If these conditions are absent, the connectors generate an error log and lists the missing data, simplifying system administration and trouble-shooting. Missing data, incomplete data, or inaccurate data may degrade the quality of a business performance management solution and substantially hinder the business results.

To generate consistently high data quality, the connectors 140 contain transformation functions that format and integrate source data before it is stored in a data mart. This process might involve any number of functions: restructuring data files, records, and fields; removing superfluous data; decoding and translating field values to enhance data; improving data readability; validating data; calculating new values from one or more source columns; simplifying data; and changing data types. The transformation process may also reject records that do not satisfy business rules. As part of the transformation process, the data warehouse system 100 may employ surrogate keys that substitute for natural keys to improve processing performance.

Once the source data has been transformed, the data warehouse system 100 loads it into the destination data marts and make the data available to users 20 for analysis and reporting. The data model 120 may be considered as an abstract collection of data marts.

The components of the data warehouse system 100 may apply different updating rules to different tables depending on the nature of the component data. By tailoring the data-loading process to the data, the data warehouse system 100 updates information faster with less demand on the target system. For instance, tables defined

as "static" contain data that changes infrequently and therefore needs refreshing only on an *ad hoc* basis. Tables that require more frequent refreshing can be treated differently as well, according to the characteristics of their data. Users 20 may perform a complete refresh, a changed-data capture, or a slowly changing dimension.

The data warehouse also includes stop-recover strategy, which allows extraction jobs that have been interrupted to be restarted. This feature saves administrators time and helps ensure data integrity.

To help ensure that an integrated data warehouse accurately captures changes to dimensions 112 that vary infrequently, such as product hierarchies, sales regions, and so on, the data warehouse system 100 may accommodate slowly changing dimensions. This feature offers two primary benefits. First, it may allow users 20 to go back and find out what was going on at a point in corporate history. In other words, although employees may have moved or sales territories may have been redrawn, the system 100 may present information about these slowly changing dimensions as they existed at the time of interest. This may allow users 20 to derive consistent, repeatable results, solidifying the value of their decision support system by preserving history.

Second, users 20 may see values or changes over time. This capability furnishes the insight to uncover longer-term trends and business impacts. If users 20 have incomplete historical information, they may end up making improper assumptions and compromising the quality of their decisions. Whereas ERP systems 10 may typically archive all but the most recent year or two's worth of data without access to supporting details, the data warehouse system 100 allows users 20 to dig into an issue's past several years or more to gain revealing perspectives about its present. This trend-analysis capability allows companies to track the impact of decisions over time.

In the data warehouse system 100, if a sales person transfers to a different region in mid year, the data marts may allow an organization to record the move and reflect the change in their database. Without record of this slowly changing dimension, a year-end revenue summary by region may allocate their entire year's sales to the new regional manager, overstating their accomplishments and understating the previous manager's performance. Companies that make decisions

based on this type of misleading information may end up making incorrect assumptions and that can result in costly mistakes.

With slowly changing dimensions, the revenue that the sales person generated before their departure will properly accrue to the previous regional sales manager, and the revenue that they generate after the move will be credited to the new manager. Over time, certain dimensions such as employees, products, and customers may change, and the data warehouse system 100, by creating another dimension record, has the flexibility to accommodate these changes and produce an accurate view of business performance.

The data warehouse system 100 handles slowly changing dimensions so that the integrated data warehouse accurately captures infrequent but important data changes. Users 20 can rely on the integrity of the data.

The data warehouse system 100 may also include changed-data capture, the capacity to periodically update the data marts with current information without rebuilding them from the ground up. Changed-data capture detects new, modified, or deleted records in source systems 10 and updates the data marts with those changes.

To improve updating speed, the data warehouse system 100 splits the changed-data capture function into two. One inserts new data incrementally in bulk, a quick and efficient approach that eases the pressure on processing resources. The other step updates changes to existing data, a process that involves going into the database, finding the modified row, updating it, and then saving the change. Given that changes are less voluminous than new data, the data warehouse system 100 handles the majority of updating with the more efficient and speedier process. Updating may therefore be conducted successfully even in the face of continually shrinking update windows.

To further its efficiency, the data warehouse system 100 may look only at the data that has changed in the ERP system 10. Recognizing the date and time of the last update, the ETL tool 140 requests only records from that update forward. Asking what records have changed and determining whether the changed records are of interest may filter this subset further. This approach demands far fewer CPU (central processing unit) resources than may be required to extract all the ERP 140 data, to compare it to the data mart, and to load the difference; a process that would involve

examining every row in the ERP 140 system. Consequently, changed-data capture improves system performance and speeds updates. Changed-data capture allows users to periodically update data marts without reloading them from scratch.

The Operational Framework 130

The operational framework 130 of the data warehouse system 100 reflects how the data warehouse system 100 may be productized. The operational framework 130 allows the administrator 21 to:

- Customize the data warehouse system 100 to reflect their unique ERP 10 environment;
- Controls the operation of the data warehouse system 100 in a production environment, and contains a component which includes stop-recover strategy; and
- Handles exceptions during data mart updates.

The operational framework 130 provides functionality that makes the data warehouse system 100 responsive to the variations of ERP 10 implementations. The operational framework 130 uses information stored in the operational framework schema to adjust the business-driven extractions and source-to-target mappings business rules of the connectors to reflect the requirements of the particular ERP 10 implementation. The operational framework 130 uses information stored in placeholders in the operational framework schema to determine the status of the extracts that load the data mart and to determine what new data needs to be extracted to the data mart.

The data warehouse system console 133 employs easy-to-use configuration parameters to help administrators 21 tailor components of the data warehouse system 100 to their environment. As has been stated above, the system console 133 assists in the configuration of the dimensional framework.

As has been described, the operational framework may include a configuration unit 135. An administrator 21 may likely customize their SAP, Oracle, or J.D. Edwards source system. If so, their hierarchies, hierarchy types, status codes, charts of accounts, exchange rates types, and other fields may differ from the source system defaults. The system console 133 has parameters which help users configure the data

warehouse system 100 to reflect these changes. This convenience saves an administrator 21 effort, speeds configuration, and delivers business performance management value faster.

Figure 18 is a screen shot of the system console 133 which enables administrators 21 to augment the data warehouse system 100 to reflect their particular implementation through configuration parameters. The system console 133 matches the configuration to the user's 20 target database and equipment. For example, whether Oracle RBDMS (TM) or Microsoft SQL Server (TM) on NT or Unix platforms are used, the data warehouse system console 133 may tailor its implementation to the physical environment.

The system console 133 enables users to import historical ERP 10 data at a pace convenient to their business. This initial load job may take a long time, a potential problem if administrators 21attempt to import all this data during a single extended window. Using the system console 133, however, administrators 21 may schedule the loading to occur in phases which users set and populate the data marts during slow network activity periods. This convenience avoids saddling users with degraded network performance while the loading occurs.

Administrators 21 may also use the system console 133 to simplify the ongoing ETL processes 140. It may help administrators 21 sequence jobs and determine which are to run, what data they are to extract, and when they are to run (i.e., date ranges). The system console 133 may also enable administrators 21 to run *ad hoc* jobs or put scheduled jobs on hold.

Moreover, the system console 133 may equip administrators 21 to maintain their system. In the data warehouse system 100, administrative tables within the relational database store information pertaining to the system's 100 operation. The console 133 uses this information to generate job status reports and error reports, giving administrators 21 a firm handle on their system at all times.

The engine behind the data warehouse system 100 resides within the system console 133, an easy-to-use production control environment that simplifies the up front installation, configuration, and loading of the data warehouse system 100. It also makes maintaining the data marts easier once they are up and running.

Administrators 21 may use the system console 133 to set extraction sequences, and establish dependencies and priorities. It may also enable organizations to implement co-ordinated analytic applications incrementally and manage them centrally.

As has been stated, the system console 133 may be considered part of the operational framework 130. The system console 133 provides intelligent connector 140 job control for *ad hoc* or scheduled data loads, sequences extraction jobs, and defines extract dates. It allows an administrator 21 to set configuration parameters so that the data warehouse system 100 reflects ERP 10 site-specific configurations. Figure 19 is a screen shot of the system console 133 that manages connector 140 processes automatically.

The Content Explorer 150

The data warehouse system 100 may also provide packaged reports, OLAP cubes, and catalogs 151 that offer business insight and reflect the information and KPIs used to manage, measure, and improve business performance in each functional area. These reports may be included in the content explorer 150.

Users 20 may generate an array of reports, such as OLAP, relational, standard, *ad hoc*, time trend, etc., to meet information requirements, for positions in the organization. Moreover, these reports are also easy to change. Decision makers can easily adapt them to manage, measure, and improve business performance in their functional areas, greatly reducing the burden on IT. Either way, knowledge workers gain key business insight and derive immediate productivity gains.

Furthermore, the data warehouse system 100, which may be extended to include scorecarding and visualizations, provide the right report for the right users on the client platform of choice: e.g., Windows, Excel, or Web browser, whether users are LAN-based or working remotely.

The data warehouse system 100 contains a number of packaged reports that reflect the business requirements for important areas such as finance, sales, and inventory. Figure 20 is a screen shot of an example of a report of the financial (or GL) analysis 403 functional area. This report helps speed reconciliations, period-end closings, and financial reporting and distribution by giving managers the information

they use to analyze income statements, balance sheets, cash flows, key financial ratios, or currency rate conversions.

Types of financial reports available to end users include:

- Overview reports, such as income statement and balance sheet;
- Income statement analysis;
- Balance sheet analysis;
- Budget analysis;
- Analysis by legal entity;
- Analysis by management entity; and
- Operational reports, such as cost center and GL Analysis 303.

Figure 21 is a screen shot of an example of a report of the sales analysis 401 functional area. This report allows users to analyze forecast accuracy and sales volume, calculate average deal size, and examine revenues and profitability, etc.

Types of sales reports available to end users 20 include:

- Reports by customer, such as customer sales ranking or customer sales by region;
- Reports by product, such as order summary, or product sales ranking;
- Reports by sales organization, such as orders by reps or by country;
- Reports by profit; and
- Reports by quantity sold.

Figure 22 is a screen shot of an example of a report of the inventory analysis 405 functional area. This report provides inventory managers with the information they use to understand supply chains and assess demand forecasting accuracy, inventory carrying costs, supplier performance, and warehouse performance, etc.

Types of inventory reports available to end users include:

- Inventory performance, such as stock level overview or profile of plants by stock level;
- Demand analysis, such as stock usage comparisons, or materials profile of demand;
- Material tracking;

- Vendor analysis by stock movements; and
- Resource activity, such as activity comparisons or plant/employee analysis.

The data warehouse system 100 also allows for ease of report generation. Figures 23 to 24 illustrate the ease with which a series of reports may be generated from any starting point. For example, Figure 23 shows a screen shot of a report highlighting sales revenues over the past several years By Division (identified by arrow 2501). A user 20 may decide that it would be interesting to view revenues over these periods by sales office within the sales organization. To generate this report, the user 20 would simply move the cursor over the Sales Office folder, shown by circle 2502, then drag and drop it on the Divisions column shown within circled 2503.

This single step presents the user with a new report which represents sales revenues over time by sales office within, in this example, the Germany Sales Organization. This analysis may be taken one step further by dragging and dropping the materials file (identified by circle 2601 in Figure 24) to the nested row position in the report, (identified by thick vertical line 2602 within circle 2603). Figure 25 shows a screen shot of the result: a new report, identified by arrow 2701, highlighting how revenues are distributed by material groups across sales offices within, in this example, the German sales organization.

Thus, with three clicks, a user 20 is able to view three reports, each of which offer sales related information. Similarly, each of these reports are only clicks away from more varied and valuable analysis.

Other components can be added to the data warehouse system 100 environment.

Methodology for creating the data warehouse System

Creating and implementing a successful traditional integrated data warehouse involves a lengthy series of complex steps and activities, and requires expertise in numerous highly specialized areas.

Despite the substantial hurdles, some information technology (IT) departments elect to build data warehouses themselves. It is not unusual for these projects to end

up over budget, miss major milestones, or even fail due to the unanticipated complexity of extracting, transforming, and loading the right data.

The data warehouse system 100 offers an integrated analytic solution, rich and complete enough for multiple organizations to use it, that allows IT departments to provide users with high quality cross-functional business performance management in a short time, freeing up specialized IT resources for immediate impact. The data warehouse solution puts robust decision-making solutions in the hands of users quickly and cost-effectively.

A data warehouse system 100 rich and complete enough to be used by multiple organizations may save users a complete business cycle in deploying and extending their integrated data warehouse solution. A complete business cycle can be spent on establishing end-user needs, data mart design, source system analysis, data mart creation, target system and configuration environment, data mart operation, and business analysis and report. The data warehouse system 100 (including the initial load, user acceptance, and implementation) requires considerably less time to install than conventional solutions creating an integrated data warehouse from scratch.

The development of an effective data warehouse system 100 includes several key components, such as:

- Business decision maker requirements (both functional and cross-functional) defining the type of analysis required based on best practices
- A technical design which ensures consolidated data from across the organization (i.e., ERPs and other data sources), delivering consistent and reliable results
- A strategic architecture which allows for incremental implementation business performance management by functional area
- Enterprise Business Intelligence (EBI) designed to deliver rich analysis and reporting, with the functionality to share information across the organization, as well as across corporate intranets and extranets with key business partners

The data warehouse system 100 may be viewed as a series of business analytical solutions designed to deliver key information to an organization's core business functions, including sales, accounts receivable (AR), general ledger (GL), accounts payable (AP), inventory management and procurement. While each application includes rich functional analysis, applications can be used together to join other operational data from across the demand and supply sides of the organization for a coordinated enterprise view of performance.

Each data warehouse system 100 business analytical solution may be built on three pillars:

- Rich business content with predefined BI reports based on best practices as defined through research with industry experts
- Robust technical architecture, ERP source analysis, installation wizards, and production system management
- Conforming design allowing for the combination of multiple applications based on common dimensions (e.g., customers, products, vendors)

The data warehouse system 100 brings together the components used to deliver the important business analysis required for effective decision making. This includes source ERP system 10 analysis, data extraction and transformation, best practices, data architecture and EBI.

Before attempting to build an integrated data warehouse, IT departments should fully assess the obstacles and risks involved. An integrated data warehouse project uses a diverse array of skills and experience. The following six skill-sets are important to a successful implementation.

1. Business Requirements Analyst:

   Acts as liaison between the data warehouse project team and the warehouse's end users. This person identifies and documents the needs of the business and produces a plan for addressing these needs using the data warehouse. The Business Requirements Analyst should have excellent communications skills and an ability to assess business information needs.

2. Subject Matter Experts:

Typically end users who are familiar with the information and business needs of the internal groups or areas that they represent and who have significant knowledge of the data. These people help standardize on different aspects related to the data and work to resolve issues across business areas.

3. Source Systems Experts:

Identifies source fields based on the requirements specified for the warehouse. Also identifies the source hurdles that will need to be overcome in order to implement.

4. Data Architect:

The Data Architect develops and maintains the logical and physical data models of the warehouse, and is able to identify the most valuable data, integrate it, and develop the correlating data model. Also responsible for recommending the optimal system of record, the Data Architect should ensure the company's business needs are incorporated into a technical solution.

5. Data Acquisition Developer and Architect:

Responsible for extracting data from a source system, performing associated transformations, and making the data available for loading into the data warehouse. The Data Acquisition Developer and Architect should understand extraction and transformation, identify transformations, and define source-to-target mappings.

6. Business Intelligence (BI) Developer:

Develops solutions that allow end users to easily and consistently access the data warehouse. The BI Developer should understand the business needs, be able to incorporate these into technical solutions, and be skilled in end-user access, reporting, and analysis tools.

Assembling the necessary skills and expertise is the first step of many involved in the process of successfully developing an integrated data warehouse. Building an integrated data warehouse includes the following process.

1. Establishing End-User Needs

- Business requirements analysis

2. Data Mart Design
    - Logical data model
    - Physical data model
3. Source System Analysis
    - Source system analysis and mappings
4. Data Mart Creation
    - Data acquisition process design
    - Data acquisition construction
5. Target System and Configuration Environment
    - Technical architecture design
6. Data Mart Operation
    - Maintenance and administration
7. Business Performance Management (which includes Business Analysis and Reporting) (Business Intelligence) and other features described herein
    - Data access design
    - Data access construction

Establishing end user needs through assessing business requirements may take up to 50% of the entire effort of building a warehouse.

An IT department should know its users' business requirements. How will people use information? What questions do they need answered? Do they want high-level views or transaction details? Will they use this information in their offices or on the road? By exploring users' business requirements, and fully understanding how the departments of the enterprise interact, a user will be ready to create the appropriate metrics and business rules an effective analysis and reporting solution requires. Including the content in the warehouse that effectively supports business goals is a key to achieving maximum return on investment.

Designing data marts involves turning the business needs that have been identified into useful data. The process involves designing the data mart logical data model and the subsequent physical data model. Many questions should be answered at this stage: Which end users should be involved during the design sessions? Do data sources exist for some or all of the intended data? Have they chosen an ETL

tool? Will the initial design include metadata? If so, will it comprise technical metadata, business metadata, or both?

Once these questions are addressed, to optimize the solution for business performance management, a high-speed star schema data marts that logically arrange data and allows for cross-functional views of business operations should be designed. Simply put, the star schema data marts, based on relational data, use shared, conformed dimensions to achieve a unified view of traditional processes. In effect, a Sales data mart would define "Product X" the same way that the Inventory data mart does. These marts should also be scalable and contain embedded knowledge of the data warehouse applications they will serve.

The next step, source system analysis, should be undertaken by someone who is familiar with the user's ERP, e-commerce, and other source systems as well as any modifications that they have made to them. This expertise is used to identify which data to extract and how to extract it.

The source system expert should understand the unique parameters, fields, hierarchies, and technical approaches that characterize each ERP solution. Many organizations outsource the initial design of their ERP and e-commerce systems to consultants who take their source expertise with them once the contract is completed. This, coupled with the high rate of movement of in-house IT resources leaves companies with a knowledge gap regarding these complex source systems. The solution is typically to retain consulting expertise, which can become prohibitively costly and, depending on a consultant's availability, even delay the solution delivery date.

Once one knows where to look for data in the source systems, their next step is to develop source to target mappings and ensure that they extract, transform, and load ERP and other data into their data marts. Poor source data quality, missing source data, and redundant source data, among other challenges, can complicate this process.

Ultimately, the ETL system should flag errors during the ETL process, minimize computing resources, maximize automation, and incorporate best warehousing practices such as slowly changing dimensions, history preservation, and changed-data capture. Delivering these capabilities will ensure that the process runs as smoothly as possible and that the data generated is accurate.

One should also know how to incrementally add data marts. For instance, if a user adds an inventory mart to their existing sales and finance marts, the user should be careful to avoid creating data definition conflicts between the marts. Synchronization and coordination are key because problems at this stage can sabotage data integrity.

The target system and configuration environment need to be checked. For example, is one using an NT application server to run an ETL code and populating an Oracle database on a Unix platform? Or are they running their ETL code on Unix and populating a Microsoft SQL server on NT? Depending on the platform and database, one will have to vary the way that they install and configure their solution.

Tasks associated with operating, managing, and maintaining the integrated data warehouse include loading data marts from operational systems, troubleshooting the system, restarting failed jobs, and scheduling jobs so that they minimize impact on source systems. Building an integrated data warehouse from scratch requires substantial IT expertise, not to mention substantial time and money.

A preferred methodology 3000 for creating a business model 110 in accordance with the present invention will be described referring to Figure 26. The first step involves selecting a market (3001). In this market, organizations to which the business model 110 will apply are identified (3002). An identified organization in the market is analyzed to collect organizational information (3003). Then business questions are determined based on the collected organizational information (3004). This collection of organizational information and determination of business questions is performed for each identified organization in the selected market (3005). The business questions of the organizations in the selected market are then merged into areas of analysis (3006). The areas of analysis are then decomposed into dimensions, measures and attributes to help answer the business questions (3007). The business model may now be designed based on the dimensions, measures and attributes (3008).

A preferred methodology 2000 for creating a data warehouse system 100 in accordance with the present invention is described referring to Figures 27A to 27E. There are four main steps in this methodology: business model development (2001), requirements definition (2011), configurable data warehouse model specification (2020), and configurable data warehouse product development and packaging (2030).

The first two main steps (2001) and (2011) create the business model 110. The first main step is to develop an organizational model (2001). The second main step is to define requirements of an organization (2011). In the development of an organizational model (2001), many organizations in a selected market are analysed to determine their requirement in a business model 110. In the requirements definition (2011), the requirements determined in the first main step (2001) are defined into components of a business model 110, i.e., dimensions 112 and areas of analysis 111.

The first main step establishes the correct framework for analyzing, grouping and managing business performance measurements. This framework is responsive to a "horizontal" view of the industries of interest. The first step in developing an organizational model is to select a market (2002). The selected market will help to define the set of characteristics that will determine the types of organizations to which the business model 110 will apply, i.e., define the target sectors and industries. The next step is to identify development partners who are representative of aspects of the selected market (2003). Development partners include end user companies, industry experts, and related professional associations and/or organizations.

The next step is to investigate the key business drivers of the selected market (2004). This step may be broken down into investigating the corporate imperatives and investigating best business practices of organizations in the selected market. Identifying the key business drivers and best business practices defines the highest level of the "metric" framework. This process provides focus and scope to the set of measures that are necessary to the successful data warehouse system solution.

The next step is to identify the "big" questions (i.e., business questions) that should be answered to manage the business performance of organizations in the selected market (2007). This establishes the high level "areas of analysis" within the business model 110. An area of analysis 203 can represent the set of metrics required to answer one or more business questions.

The next step is to define an organizational model that represents the typical business functions of the organizations in the selected market (2008). This step may involve defining the main functions as well as the main business functions of the organizations. This step combines all the findings of the previous steps into a

business model 110 that represents the core functional areas 202 typical to a company within the target market industries and sectors.

As has been stated above, once the requirements of the organizations in the selected market have been determined (2001), the requirements may be defined into components of a business model 110. Each functional area of the organizations, determined in the organizational model development (2001) should be developed into a data warehouse system 100 application. The first step in the requirements definition is to select a functional area to develop into a data warehouse system 100 application (2012). The business process of the selected area may be divided into activities and tasks (2013). The decomposition of the functional area 202 is used to understand the workflow, business process and roles that are to be measured and managed in a data warehouse system 100. Then key roles involved in the data warehouse system 100 application should be identified (2014). Next, a list of business questions to be answered during business performance management may be developed (2015). Steps (2012) to (2015) are repeated for each functional area determined in the first main step (2001). The set of business questions represents the questions that should be answered to determine if the objectives and goals of performance (typically established in the corporate imperatives) are being met. Each question should be stated according to a standard specification. A question should contain one and only one metric, and may contain one or more dimensions, and attributes.

The business questions determined in step (2015) may now be grouped into areas of analysis 111 (2016). The business questions (often hundreds) are grouped into their related area of analysis 203. The areas of analysis 203 were defined during the creation of the business model 110. Grouping business questions this way can be used to verify the business model 110 and establish the corresponding data model 120 parameters. The business questions may also be decomposed into measures, dimensions and attributes (2017) and documented as business requirements (2018). Finally, functional requirements which define how the questions are to be answered may be documented (2019). Documenting the functional requirements includes the identification of configuration options necessary to support multiple organizations.

Referring back to Figure 10, the functional areas determined in step (2001) are denoted as A_1 to A_y. The dimensions determined in step (2017) are denoted as D_1 to

Dn. Multiple areas of analysis determined in step (2016) are included in the functional areas A_1 to A_y. Multiple measures and attributes determined in step (2017) are also included in the functional areas A_1 to A_y. The connecting lines 390 show which dimensions 112 are used with each functional area 111 to answer the business questions determined in step (2015). Finally, the boxes outlining the different organizations show which dimensions are functional areas are needed by a particular organization.

The creation of the business model 110 was the first two steps in the methodology of the development of the data warehouse system 100. Once the business model 110 has been created, a data model 120 may be created to implement the business model 110. Moreover, the data model 120 may be configurable and joined to a data warehouse system 100.

The third main step in the development of a data warehouse system 100 is to create a configurable data warehouse model specification (2020). In this main step, a data warehouse model specification is designed (2021) to answer the business questions determined in step (2015). A high level functional specification may also be designed to show how these business questions are to be answered (2022). The next step is to analyze selected source systems 10 to determine how and what to extract to meet the defined requirements (2023) for: business concepts, business processes, data entities, and data life cycle information. The source system analysis step is used to identify the configuration options used to support the possible implementation specific variations of multiple organizations. Then source system 10 specific variations should be identified for each source system 10 (2028). Finally, implementation specific various should be identified within each source system 10 (2029).

The last main step in the development of a data warehouse system 100 takes all the information and analysis performed thus far and develops a product. This last main step involves the configurable data warehouse product development and packaging (2030). This first step in this last main step is to design the configurable version of the data model 120 and connectors 140 (i.e., ETL code) (2031). This involves designing the configurable target elements (i.e., the fact tables 121 and dimension tables 122) and designing the configurable extraction code used by the

ETL. Next, the configurable aspects of the solution are implemented in the configuration unit 135 (2034). Finally, the complete solution may be packaged as a product (2035). This last step results in the specification for the configuration unit 135 which enables the selection of the various configure options in the data model 120 and the connectors 140.

Further information regarding an example of an embodiment of a data warehouse system 100

Dimensions

The following is a listing of dimensions which may be used in a data warehouse system 100:

ACCOUNT CATEGORY PARTY
ACCOUNTING DOCUMENT CLASS
ALL TIME
AP ACTIVITY DETAIL
AP ACTIVITY DOCUMENT
AP DAILY ACTIVITY SUMMARY
AP INVOICE SUMMARY
AP MONTHLY ACCOUNT SUMMARY
AP MONTHLY ACTIVITY SUMMARY
AP PAYMENT SUMMARY
AR ACTIVITY DETAIL
AR ACTIVITY DOCUMENT
AR DAILY ACTIVITY SUMMARY
AR INVOICE SUMMARY
AR MONTHLY ACCOUNT SUMMARY
AR MONTHLY ACTIVITY SUMMARY
AR PAYMENT SUMMARY
BATCH
BUDGET VERSION
BUSINESS AREA
CHART OF ACCOUNT
COMMITTMENT ACTIVITY DETAIL
COMMITTMENT ACTIVITY DOCUMENT
COMPANY CONSOLIDATION
CONTRACT ACTIVITY DETAIL
CONTRACT ACTIVITY DOCUMENT
CONTRACT DOCUMENT SUMMARY
CONTROLLING COST OBJECT
CONTROLLING COST OBJECT GROUP MEMBER
COST ACCOUNT ACTUAL
COST ACCOUNT ACTUAL DOCUMENT

COST ACCOUNT PLAN ITEM
COST ACCOUNT PLAN ITEM HEADER
COST ACCOUNT PLAN VERSION
COST CENTER
COST CLASS
COST ELEMENT
COST ELEMENT GROUP MEMBER
COSTING GROUP
COSTING PROJECT
CUSTOMER
CUSTOMER DEMOGRAPHIC
EMPLOYEE
EURO CURRENCY RATE
FINANCIAL CURRENCY CONVERSION
FISCAL
FLEXIDIM
GL ACTIVITY DETAIL
GL ACTIVITY DOCUMENT
GL BALANCE
GL BUDGET
MATERIAL
MATERIAL MOVEMENT
MATERIAL MOVEMENT DOCUMENT
MATERIAL MOVEMENT DOCUMENT CLASS
MATERIAL MOVEMENT DOCUMENT SERIAL NUMBER
MATERIAL RESERVATION
MATERIAL STORAGE
ORGANIZATION
PHYSICAL INVENTORY
PLANT
PROCUREMENT ACTIVITY PERIODIC SUMMARY
PROCUREMENT DOCUMENT CLASS
PROCUREMENT STATUS
PROFIT CENTER
PROMOTION
PURCHASE ORDER ACTIVITY DETAIL
PURCHASE ORDER ACTIVITY DOCUMENT
PURCHASING ORGANIZATION GROUP
QUOTATION ACTIVITY DETAIL
QUOTATION ACTIVITY DOCUMENT
RELEASE STRATEGY
REQUISITION ACTIVITY DETAIL
REQUISITION ACTIVITY DOCUMENT
SALES ACTIVITY PERIODIC SUMMARY
SALES BILLING
SALES BILLING DOCUMENT
SALES CONTRACT

SALES CONTRACT DOCUMENT
SALES DISTRIBUTION
SALES DISTRIBUTION DOCUMENT
SALES DOCUMENT CLASS
SALES ORDER
SALES ORDER DOCUMENT
SALES ORGANIZATION
SALES STATUS
SHIPPING POINT
STOCK CLASS
STOCK LEVEL DAY
STOCK LEVEL MONTH
STOCK LEVEL WEEK
STOCK OPENING BALANCE
STOCK OVERVIEW
STOCK USAGE FORECAST
STOCK USAGE FORECAST VERSION
STOCKOUT
STORAGE BIN
TIME
UNIT OF MEASURE
UNIT OF MEASURE CONVERSION
USER CATEGORY
VALUATION
VENDOR
VENDOR PROFILE
WORK ORDER

Functional areas 203, Areas of analysis 202, and measures 111

Referring back to Figure 16 and Figures 17A to 17AE, the following is a listing of areas of analysis 202 and their measures 111 which may be used in a data warehouse system 100:

Sales

The sales functional area 1703 data model component may include Sales Distribution Detail 1722, Sales Billing Detail 1723, and Sales Order Detail 1724 data structures. The sales functional area 1703 data model component may also include Slaes Contract Detail and Sales Activity Summary data structures.

The Sales Distribution Detail 1722 data structure may comprise:

- Actual Delivered Base Unit Quantity
- Actual Delivered Sale Unit Quantity

- Company Code
- Actual Goods Issue Date Sid
- Changed Date
- Complete Delivery Indicator
- Created Date
- Delivered Date Sid
- Distribution Channel Code
- Document Currency Code
- Group To Document Currency Conversion Rt
- Document Currency Extended Cost Amount
- Document Currency Extended Net Price Amt
- Document Currency Extended Net Value Amt
- Document Item Number
- Document Number
- Document Type Code
- Group Currency Code
- Group Currency Extended Net Price Amount
- Group Currency Extended Net Value Amount
- Loaded Date Sid
- Local Currency Code
- Group to Local Currency Conversion Rate
- Local Currency Extended Net Price Amount
- Local Currency Extended Net Value Amount
- Next Planned Shipping Date Sid
- Order Combination Indicator
- Planned Goods Issue Date Sid
- Priority Delivery Code
- Requested Delivery Date Sid
- Scheduled Transportation Date Sid

The Sales Billing Detail 1723 data structure may comprise:

- Adjustment Identifier
- Changed Date

- Created Date
- Customer Transaction Line Number
- Customer Transaction Number
- Document Currency Code
- Group to Document Currency Exchange Rate
- Document Currency Extended Cost Amount
- Document Currency Extended Price Amount
- Document Currency Cash Discount Amount
- Document Currency Freight Amount
- Document Currency Tax Amount
- Document Item Number
- Document Number
- Document Type Code
- Group Currency Code
- Group Currency Discount Amount
- Group Currency Extended Price Amount
- Group Currency Cash Discount Amount
- Group Currency Freight Amount
- Group Currency Profit Margin Amount
- Group Currency Tax Amount
- Local Currency Code
- Group to Local Currency Exchange Rate
- Local Currency Extended Price Amount
- Local Currency Cash Discount Amount
- Local Currency Freight Amount
- Local Currency Tax Amount

The Sales Order Detail 1724 data structure may comprise:

- Changed Date
- Created Date
- Document Currency Code
- Group To Document Currency Conversion Rt
- Document Currency Discount Amount

- Document Currency Extended Cost Amount
- Document Currency Extended Price Amount
- Document Currency Profit Margin Amount
- Document Currency Freight Amount
- Document Currency Tax Amount
- Document Item Number
- Document Number
- Document Type Code
- Group Currency Code
- Group Currency Discount Amount
- Group Currency Extended Cost Amount
- Group Currency Extended Price Amount
- Group Currency Freight Amount
- Group Currency Profit Margin Amount
- Group Currency Tax Amount
- Local Currency Code
- Group to Local Currency Conversion Rate
- Local to Document Currency Conversion Rt
- Local Currency Discount Amount
- Local Currency Extended Cost Amount
- Local Currency Extended Price Amount
- Local Currency Freight Amount
- Local Currency Profit Margin Amount

AR

The AR functional area 1705 data model component may include AR Activity Detail 1728, AR Daily Activity Summary 1729, AR Monthly Activity Summary 1730, and AR Monthly Account Summary 1731 data structures. The AR functional area 1705 data model component may also include AR Invoice Summary and AR Payment Summary data structures.

The AR Activity Detail 1728 data structure may comprise:

- Debit Multiplier
- Credit Multiplier

- Local Currency Amount
- Local Currency Net Amount
- Local Currency Tax Amount
- Local Currency Discount Amount
- Local Currency Cost Amount
- Local Currency Freight Amount
- Local Currency Profit Margin Amount
- Group Currency Amount
- Group Currency Net Amount
- Group Currency Tax Amount
- Group Currency Discount Amount
- Group Currency Cost Amount
- Group Currency Freight Amount
- Group Currency Profit Margin Amount
- Created Date
- Changed Date

The AR Daily Activity Summary 1729 data structure may comprise:

- Daily Open Transaction Count
- Daily New Transaction Count
- Daily Total Open Item Amount
- Daily Total New Item Amount
- Daily Total Transaction Amount
- Daily Total Gross Sales Revenue Amount
- Daily Total Net Sales Revenue Amount
- Daily Total Revenue Amount
- Daily Average Transaction Amount
- Daily Average Gross Sales Revenue Amount
- Daily Average Net Sales Revenue Amount
- Daily New To Open Amount Ratio
- Daily New To Open Count Ratio

The AR Monthly Activity Summary 1730 data structure may comprise:

- Monthly Open Transaction Count

- Monthly New Transaction Count
- Monthly Discount Taken Transaction Count
- Monthly Discount Refused Transaction Count
- Monthly Total Transaction Amount
- Monthly Profit Amount
- Monthly Average Transaction Count
- Monthly Average Transaction Amount
- Monthly New to Open Transact Count Ratio
- Monthly New to Open Transac Amount Ratio
- Monthly Average Daily Sales Volume
- Monthly Average Collection Period
- Monthly Value Past Due Amount
- Monthly Trade Discount Cost Amount
- Monthly Effect on Bottom Line Amount
- Monthly Collection Effectiveness Index
- Dollar Weighted Avg Days Outstanding Amt
- Dollar Weighted Avg Days Beyond Term Amt
- Dollar Weighted Average Days to Pay Amt
- Monthly Net Credit Period
- Monthly AR Account Balance Amount
- Created Date
- Changed Date

The AR Monthly Account Summary 1731 data structure may comprise:

- Monthly Average Cost To Serve Amount
- Monthly Avg Invoice Payment Day Count
- Monthly Cost to Serve Amount
- Monthly Average Daily Sales Volume
- Monthly Average Collection Period
- Monthly Value Past Due Amount
- Monthly Trade Discount Cost Amount
- Monthly Effect on Bottom Line Amount
- Monthly Average Deliquent Day Count

- Monthly Collection Effectiveness Index
- Dollar Weighted Avg Days Outstanding Amt
- Dollar Weighted Avg Days Beyond Term Amt
- Dollar Weighted Average Days to Pay Amt
- Monthly AR Account Balance Amount

GL

The GL functional area 1704 data model component may include GL Activity Detail 1725, GL Balance 1726, and GL Budget 1727 data structures.

The GL Activity Detail 1725 data structure may comprise:

- Local Currency Amount
- Local Currency Credit Amount
- Local Currency Debit Amount
- Local Currency Net Amount
- Group Currency Credit Amount
- Group Currency Debit Amount
- Group Currency Net Amount
- Changed Date
- Created Date

The GL Balance 1726 data structure may comprise:

- Changed Date
- Created Date
- Group Currency Close Bal Amount
- Group Currency Period Credit Amount
- Group Currency Period Debit Amount
- Group Currency Period Net Activity Amt
- Group Currency Period Open Bal Amount
- Group Currency Year Open Bal Amount
- Group Currency YTD Credit Amount
- Group Currency YTD Debit Amount
- Group Currency YTD Net Activity Amount
- Local Currency Close Bal Amount
- Local Currency Period Credit Amount

- Local Currency Period Debit Amount
- Local Currency Period Net Activity Amt
- Local Currency Period Open Bal Amount
- Local Currency Year Open Bal Amount
- Local Currency YTD Credit Amount
- Local Currency YTD Debit Amount
- Local Currency YTD Net Activity Amount
- Year End Indicator

The GL Budget 1727 data structure may comprise:

- Changed Date
- Created Date
- Group Currency Close Bal Amount
- Group Currency Period Activity Amount
- Group Currency Period Open Bal Amount
- Group Currency Year Open Bal Amount
- Group Currency YTD Activity Amount
- Local Currency Close Bal Amount
- Local Currency Period Activity Amount
- Local Currency Period Open Bal Amount
- Local Currency Year Opening Bal Amount
- Local Currency YTD Activity Amount

AP

The AP functional area 1706 data model component may include AP Activity Detail 1732, AP Monthly Activity Summary 1733, AP Monthly Account Summary 1734, and AP Daily Activity Summary 1735 data structures. The AP functional area 1706 data model component may also include AP Invoice Summary and AP Payment Summary data structures.

The AP Activity Detail 1732 data structure may comprise:

- Local Currency Amount
- Local Currency Net Amount
- Local Currency Tax Amount
- Local Currency Discount Taken Amount

- Local Currency Discount Allowed Amount
- Local Currency Freight Amount
- Group Currency Amount
- Group Currency Net Amount
- Group Currency Tax Amount
- Group Currency Discount Taken Amount
- Group Currency Discount Allowed Amount
- Group Currency Freight Amount
- Total Payment Days Count
- Payment Term Day Count
- Payment Discount Day Count
- Created Date
- Changed Date

The AP Monthly Activity Summary 1733 data structure may comprise:

- New Transaction Count
- Open Transaction Count
- Discount Taken Transaction Count
- Discount Refused Transaction Count
- New Transaction Amount
- Open Transaction Amount
- Discount Taken Amount
- Discount Available Amount
- Created Date
- Changed Date

The AP Monthly Account Summary 1734 data structure may comprise:

- AP Account Balance Amount
- Average Days Past Due Count
- Average Collection Period
- Bad Debt Amount
- Invoice Count
- Invoice Amount
- Payment Count

- Payment Amount
- Adjustment Count
- Adjustment Amount
- Best Possible DPI Ratio
- Bottom Line Effect Amount
- Payment Effectiveness Index
- Cost To Serve Amount
- Days of Purchases Instanding Ratio
- Net Credit Purchases Amount
- Past Due Amount
- Trade Discount Profit Amount
- Trade Discount Offered Amount
- Dollar Weighted Avg Days Beyond Term Amt
- Past Due Count
- Dollar Weighted Avg Days Outstanding Amt

The AP Daily Activity Summary 1735 data structure may comprise:

- Open Transaction Count
- New Transaction Count
- Discount Taken Transaction Count
- Discount Refused Transaction Count
- Discount Taken Amount
- Discount Available Amount
- Open Transaction Amount
- New Transaction Amount
- Total Gross Sales Revenue Amount
- Total Net Sales Revenue Amount
- Total Revenue Amount
- Past Due Amount
- Average Transaction amount
- Average Gross Sales Revenue Amount

- Average Net Sales Revenue Amount

Inventory

The Inventory functional area 1702 data model component may include Stock Usage Forecast 1713, Physical Inventory 1714, Material Reservation 1715, Stock Overview 1716, and Material Movement 1721 data structures.

The Stock Usage Forecast 1713 data structure may comprise:

- Forecast First Day Date
- Modified Forecast First Day Date
- Forecast Period Number
- Forecast Value
- Corrected Value
- Seasonal Index Value
- Created Date
- Changed Date

The Physical Inventory 1714 data structure may comprise:

- Document Number
- Document Item Number
- Inventory Fiscal Year
- Book Stock Level Count
- Book Stock Document Cur Extndd Val Amt
- Book Stock Group Currency Extndd Val Amt
- Book Stock Local Currency Extndd Val Amt
- Physical Inventory Count
- Physical Inventory Grp Cur Extnd Val Amt
- Final Count Indicator
- Absolute Stock Accuracy Percentage
- Relative Stock Accuracy Percentage
- User Name
- Last Count Date Sid

The Material Reservation 1715 data structure may comprise:

- Document Number
- Document Item Number

- Reservation Date
- Reserved Quantity
- Reserved Quantity Doc Cur Extndd Val Amt
- Reserved Quantity Grp Cur Extndd Val Amt
- Reserved Quantity Lcl Cur Extndd Val Amt
- Confirmed Quantity
- Withdrawn Quantity
- Confirmed Quantity Grp Cur Extnd Val Amt
- Withdrawn Quantity Grp Cur Extnd Val Amt
- Document Currency Code
- Document Currency Conversion Rate
- Group Currency Code
- Local Currency Code
- Local Currency Conversion Rate
- User Name
- Deletion Indicator
- Final Issue Indicator

The Stock Overview 1716 data structure may comprise:

- Calendar Month
- Absolute Stock Accuracy Percentage
- Average Stock Level
- Average Unrestricted Stock Level
- Closing Stock Level
- Closing Unrestricted Stock Level
- Cumulative Usage Quantity
- Forecast Usage Quantity
- Last Used Date
- Maximum Stock Level
- Maximum Unrestricted Stock Level
- Minimum Stock Level
- Minimum Unrestricted Stock Level
- Moving Average Stock Level

- Moving Average Usage Quantity
- Moving Avg unrestricted Stock Level
- Opening Stock Level

The Material Movement 1721 data structure may comprise:

- Purchase Order Number
- Purchase Order Item Number
- Document Date
- Expiration Date
- Group Currency Value
- - Movement Quantity
- Created Date
- Changed Date

Procurement

The Procurement functional area 1701 data model component may include Procurement Activity Periodic Summary 1707, Requisition Activity Detail 1708, Quotation Activity Detail 1709, Purchase Order Activity Detail 1710, Contract Activity Detail 1711, and Contract Document Summary 1712 data structures.

The Procurement Activity Periodic Summary 1707 data structure may comprise:

- Open Entered Document Count
- Open Blocked Document Count
- Open Approved Document Count
- Completed Closed Document Count
- Completed Cancelled Document Count
- Total Document Open Days Count
- Remaining Document Dollar Amount
- Total Document Value
- Changed Date
- Created Date

The Requisition Activity Detail 1708 data structure may comprise:

- Group To Local Exchange Rate
- On Hold Quantity

- Open Quantity
- Received Quantity
- Relieved Quantity
- Requested Transaction Quantity
- Group Currency Estimated Unit Price Amt
- Group Currency Extended Price Amount
- Group Currency Other Expenses Amount
- Group Currency Total Landed Cost Amount
- Group Currency Tax Amount
- Group Currency Duty Amount
- Group Currency Freight Amount
- Touch Count
- Correction Count
- Adjustment Count
- Created Date
- Changed Date

The Quotation Activity Detail 1709 data structure may comprise:

- Transaction Quantity
- On Hold Quantity
- Open Quantity
- Received Quantity
- Relieved Quantity
- Group Currency Unit Price Amount
- Group Currency Extended Price Amount
- Group Currency Other Expenses Amount
- Group Currency Total Landed Cost Amount
- Group Currency Tax Amount
- Group Currency Duty Amount
- Group Currency Freight Amount
- Group To Local Exchange Rate
- Touch Count
- Correction Count

- Adjustment Count
- Created Date
- Changed Date

The Purchase order Activity Detail 1710 data structure may comprise:

- Transaction Quantity
- On Hold Quantity
- Open Quantity
- Received Quantity
- Relieved Quantity
- Group Currency Unit Price Amount
- Group Currency Extended Price Amount
- Group Currency Other Expenses Amount
- Group Currency Total Landed Cost Amount
- Group Currency Tax Amount
- Group Currency Duty Amount
- Group Currency Freight Amount
- Group To Local Exchange Rate
- Touch Count
- Correction Count
- Adjustment Count
- Created Date
- Changed Date

The Contract Activity Detail 1711 data structure may comprise:

- Transaction Quantity
- On Hold Quantity
- Open Quantity
- Relieved Quantity
- Cumulative Received Quantity
- Received Quantity
- Group Currency Unit Price Amount
- Group Currency Target Commitment Amount
- Group To Local Exchange Rate

- Touch Count
- Correction Count
- Adjustment Count
- Created Date
- Changed Date

The Contract Document Summary 1712 data structure may comprise:

- Total Contract Dollar Value
- Remaining Dollar Value
- Created Date
- Changed Date

Reports

The following is a listing of some of the reports and groupings of reports for some functional areas:

Procurement Reporting:

MATERIAL DEMAND ANALYSIS
- Internal Customer Profile and Ranking
- Material Demand Analysis and Trends
- Demand Rationalization

VENDOR PROFILE
- Vendor Ranking
- Vendor Expenditure Overview
- Contract Activity Analysis
- Contract Analysis
- Vendor – Material Rationalization
- Vendor Profiling

OPERATIONAL EFFECTIVENESS
- Procurement Activity Overview
- Buyer Account Management Status
- Buyer Comparisons
- Procurement Process Efficiency
- Buyer Activity Overview
- Contract Usage Analysis
- Release Strategies

OPERATIONAL REPORTING
- Document Lists

Inventory Reporting:

INVENTORY PERFORMANCE

- Stock Level Overview and Comparisons
- Stock Level Analysis (Plant, Material)
- Detailed Storage Stock Levels

DEMAND ANALYSIS

- Stock Usage Overview and Comparisons
- Stock Usage Analysis
- Detailed List of Usage

MATERIAL TRACKING

- Material Movement Overview and Comparisons
- Movements Analysis

RESOURCE ACTIVITY

- Resource Activity Overview
- Activity Comparisons
- Plant/Employee Analysis

STOCK ACCURACY

- Stock Overview
- Stock Comparisons
- Stock Analysis

RESERVATIONS

- Reservations Overview
- Reservations Comparisons
- Reservations Analysis

FORECASTS

- Stock Forecast Overview and Comparisons
- Stock Forecast Analysis
- Stock Forecasts Profile

VENDOR ANALYSIS (MOVEMENTS)

- Vendor Overview and Comparisons
- Vendor Analysis
- Vendor Activity Profile

AP Reporting:

AP MANAGEMENT OVERVIEW

- Ageing Overview
- Payments Analysis
- Quality of Accounts Receivable
- Bad Debt Analysis

VENDOR ACCOUNT MANAGEMENT

- Vendor A/P Overview
- Vendor Ageing
- Top Ten Vendor Activity Report
- Overdue Accounts
- Vendor Account Overview
- Vendor Transaction Summary
- Vendor Activity Analysis
- Analysis of Adjustments

- Vendor Profile Status

VENDOR PAYABLES SCORECARDING

- Vendor Cost Analysis
- Discount Analysis

OPERATIONAL EFFECTIVENESS

- Organizational Overview
- Account Management Status
- Analyst Activity Overview
- Analyst Profile Overview
- Analyst Profile Status
- Document Flow Report

CASH OUTFLOW MANAGEMENT

- Payment Schedule
- Cash Outflow Forecasts

GL Reporting:

INCOME STATEMENT ANALYSIS

- Income Statement Time Comparisons
- Vertical Analysis
- Detailed Income Statement
- Income Statement Budget Variances

BALANCE SHEET ANALYSIS

- Balance Sheet Time Comparisons
- Balance Sheet Time Trends
- Detailed Balance Sheet
- Balance Sheet Budget Variance

FINANCIAL/LEGAL ENTITY ANALYSIS

- Company, Profit and Cost Center Comparison of Financial Reports
- Company, Profit Center and Cost Center Rankings and Comparisons
- Ratio Trends

BUDGET ANALYSIS

- Customer Profitability Analysis
- Customer Cost Analysis
- Discount Analysis

OPERATIONAL REPORTS

- Cost Center Analysis
- Account Analysis
- Trial Balance
- General Ledger Detail

KEY FINANCIAL RATIOS

Multi-dimensional analysis of key financial ratios:

- Leverage Ratios including Debt to Asset and Times Interest Earned

- Liquidity Ratios including Current, Quick Ratio, Fixed Asset Turnover, Total Asset Turnover
- Profitability or Efficiency Ratios including Profit Margin, Inventory Turnover, Return on Assets, Return on Equity

Sales Reporting:

SALES ORDER LIFE CYCLE

- Sales Orders Overview and Comparison
- Sales Orders Analysis
- Sales Order List By Customer
- Customer Order Profiles

CUSTOMER BUYING TRENDS

- Customer Buying Overview and Comparisons
- Trends Analysis
- Billings List By Customer
- Customer Ranking

SALES/PRODUCT PERFORMANCE

- Sales and Product Overview/Comparison
- Sales and Product Performance Analysis
- Sales Office and Sales Rep Performance Profiles
- Product Sales List
- Product Performance Profile

SHIPPING CHANNEL TREND/DRIVERS

- Shipping Overview and Analysis
- Shipping Channel Comparisons
- Shipping Performance Overview/Comparisons
- Shipping Profile and Document List by Product

CHANNEL PERFORMANCE

- Channel Overview and Comparisons
- Channel Performance Analysis
- Billing List by Channel; Channel Profile

DELIVERY/ON-TIME DELIVERY ANAYSIS

- Delivery Effectiveness Overview and Comparisons
- Delivery Effectiveness Analysis
- Shipping Point Profile

AR Reporting:

AR MANAGEMENT OVERVIEW

- Ageing Overview
- Collection Analysis
- Quality of Accounts Receivable
- Bad Debt Analysis

CUSTOMER COLLECTION MANAGEMENT

- Customer A/R Overview
- Customer Ageing

- Top Ten Customer Activity Report
- Overdue Accounts

CUSTOMER ACCOUNT MANAGEMENT

- Customer Account Overview
- Customer Transaction Summary
- Customer Activity Analysis
- Analysis of Adjustments
- Customer Profile Status

CUSTOMER SCORECARDING

- Customer Profitability Analysis
- Customer Cost Analysis
- Discount Analysis

OPERATIONAL EFFECTIVENESS

- Organizational Overview
- Account Management Status
- Analyst Activity Overview
- Analyst Profile Overview
- Analyst Performance Comparison
- Document Flow Report

AR AND SALES ANALYSIS

- Accounts Receivable and Sales Related KPIs
- Customer AR Sales Overview

The data warehouse system of the present invention may be implemented by any hardware, software or a combination of hardware and software having the above described functions. The software code, either in its entirety or a part thereof, may be stored in a computer readable memory. Further, a computer data signal representing the software code which may be embedded in a carrier wave may be transmitted via a communication network. Such a computer readable memory and a computer data signal are also within the scope of the present invention, as well as the hardware, software and the combination thereof.

While specific embodiments of the present invention have been described, various modifications and substitutions may be made to such embodiments. Such modifications and substitutions are within the scope of the present invention, and are intended to be covered by the following claims.

WHAT IS CLAIMED IS:

1. A data warehouse system for managing performance of organizations, the data warehouse system comprising:

a data model for storing data representing dimensions and measures applicable for multiple organizations, the data model having placeholders settable such that the data model represents a particular organization; and

a configuration unit for setting the placeholders such that the data model represents the particular organization.

2. The data warehouse system claimed in claim 1, wherein the data model implements a business model for representing the dimensions and measures applicable to the multiple organizations, the business model comprising:

a set of dimensions representing business reference aspects of the multiple organizations, a subset of the set of dimensions representing the business reference aspects of the particular organization;

a set of measures representing measurements of business activity aspects of the multiple organizations, a subset of the set of the measures representing the measurements of business activity aspects areas of the particular organization; and

relationships between the set of dimensions and the measures, the relationships allowing for the measures to use common dimensions for cross-functional analysis.

3. The data warehouse system claimed in claim 2, wherein the measures are grouped into functional areas of analysis to answer business questions applicable to the multiple organizations, a subset of the business questions used to analyze the particular organization.

4. The data warehouse system claimed in claim 2, wherein one or more dimensions contain one or more placeholders settable to reflect at least one of:

a fiscal pattern of the particular organization;

a common currency used by the data model;

one or more categories defined by a user, the categories used to analyze information in the data model; and

one or more multipliers used by the data model.

5. The data warehouse system claimed in claim 2, wherein one or more measures contain one or more placeholders settable to reflect at least one of:

a fiscal pattern of the particular organization;

a common currency used by the data model;

one or more categories defined by a user, the categories used to analyze information in the data model; and

one or more multipliers used by the data model.

6. The data warehouse system claimed in claim 1, wherein the configuration unit comprises at least one of:

a fiscal pattern settor for setting one or more placeholders in the data model to reflect a fiscal pattern of the particular organization;

a currency settor for setting one or more placeholders in the data model to reflect a common currency used by the data model;

a user category settor for setting one or more placeholders in the data model to reflect a category defined by a user, the category used to analyze information in the data model; and

a multiplier settor for aggregating amounts loaded into the data model.

7. The data warehouse system claimed in claim 1, further comprising one or more connectors for extracting data from one or more data source systems and loading the data into the data model, the connectors having parameters settable such that connectors extract data from a particular data source system.

8. The data warehouse system claimed in claim 7, wherein the connectors contain one or more placeholders settable to specify the particular data source system.

9. The data warehouse system claimed in claim 7, wherein the connectors contain one or more placeholders settable to reflect environmental settings of the particular data source system.

10. The data warehouse system claimed in claim 7, wherein the configuration unit further sets the parameters in the connectors for configuring the connectors to the particular data source system.

11. The data warehouse system claimed in claim 7, wherein the configuration unit comprises a source details settor for setting one or more placeholders in the connectors to specify the particular data source system.

12. The data warehouse system claimed in claim 7, wherein the configuration unit comprises an environmental settor for setting configuration options relating to the particular data source system.

13. The data warehouse system claimed in claim 7, wherein the connectors comprise extraction transformation loading (ETL) software code.

14. The data warehouse system claimed in claim 7, wherein the connectors comprise:

a configuration ETL code unit for extracting values from a data source system to set the placeholders in the data model and to set the parameters in the configuration unit; and

a parameterized ETL code unit for using the values to extract information from the data source system, transform the data and load the data into the data model.

15. The data warehouse system claimed in claim 1, wherein the data source systems comprise enterprise resource planning (ERP) systems.

16. The data warehouse system claimed in claim 1 further comprising an operational framework for managing the data warehouse system, the operational framework comprising a console for providing a user configuration options for configuring the

data warehouse system, wherein the configuration unit is provided in the operational framework.

17. The data warehouse system claimed in claim 1, further comprising a content explorer for generating reports based on the analysis performed by the data model.

18. A method for configuring a data warehouse system, the method comprising steps of:

obtaining a data warehouse system comprising:

a data model for storing data representing dimensions and measures applicable for multiple organizations, the data model having placeholders settable such that the data model represents a particular organization; and

a configuration unit for setting the placeholders such that the data model represents the particular organization; and

using the configuration unit to set one or more data model placeholders in the data model of the data warehouse system.

19. An operational framework for managing a data warehouse system, the operational framework comprising:

a console for configuring a data model in the data warehouse system to a particular organization and for configuring an extraction transformation loading tool to a particular data source system; and

a configuration unit, the configuration unit comprising placeholders settable to specify the particular data source system.

20. The operational framework claimed in claim 19, further comprising a console for providing administrator access to configure the data warehouse system.

21. A connector for extracting source data from multiple data source systems and transforming the data for loading into placeholders in a data model, the connector comprising:

a configuration ETL code unit for extracting values from a data source system to set the placeholders in the data model and the operational framework; and

a parameterized ETL code unit for using the values to extract information from the data source system, transform the data and load the data into the data model.

22. A dimensional framework for use as a foundation of a data warehouse system, the dimensional framework comprising a set of dimensions representing business reference aspects of multiple organizations, a subset of the set of dimensions representing the business reference aspects of a particular organization, the dimensions having placeholders settable set such that the dimensional framework represents the particular organization.

23. A method of providing a data warehouse for managing performance of organizations, the method comprising steps of:

providing placeholders in a data model, the data model for storing data representing dimensions and measures applicable for multiple organizations, the placeholders settable such that the data model represents a particular organization; and

providing a configuration unit for setting the placeholders such that the data model represents the particular organization.

24. The method claimed in claim 23, wherein the step of providing placeholders comprises the step of providing placeholders in dimensions of the data model, the dimensions representing business reference aspects of the multiple organizations.

25. The method claimed in claim 23, wherein the step of providing placeholders comprises the step of providing placeholders in measures of the data model, the measures representing measurements of business activity aspects of the multiple organizations, a subset of the set of the measures representing the measurements of business activity aspects areas of the particular organization.

26. The method claimed in claim 23, wherein the step of providing placeholders comprises steps of:

providing placeholders in dimensions of the data model, the dimensions representing business reference aspects of the multiple organizations; and

providing placeholders in measures of the data model, the measures representing measurements of business activity aspects of the multiple organizations, a subset of the set of the measures representing the measurements of business activity aspects areas of the particular organization.

27. The method claimed in claim 27, further comprising the step of providing relationships between the set of dimensions and the measures, the relationships allowing for the measures to use common dimensions for cross-functional analysis.

28. The method claimed in claim 23, further comprising the step of grouping the provided measures into functional areas of analysis to answer business questions applicable to the multiple organizations, a subset of the business questions used to analyze the particular organization.

29. The method claimed in claim 23, wherein the step of providing placeholders comprises at least one step of:

providing one or more placeholders in the data model to reflect a fiscal pattern of the particular organization;

providing one or more placeholders in the data model to reflect a common currency used by the data model;

providing one or more placeholders in the data model to reflect a category defined by a user, the category used to analyze information in the data model; and

aggregating amounts loaded into the data model.

30. The method claimed in claim 23, further comprising the step of providing one or more settable parameters in one or more connectors, the connectors for extracting data from one or more data source systems and loading the data into the data model, the parameters settable such that the connectors extract data from a particular data source.

31. The method claimed in claim 30, wherein the step of providing settable parameters comprises the step of providing settable parameters in the connectors for configuring the connectors to the particular data source.

32. The method claimed in claim 30, wherein the step of providing settable parameters comprises the step of providing one or more settable placeholders in the data model for configuring the connectors to the particular data source system.

33. The method claimed in claim 30, wherein the step of providing settable parameters comprises the step of providing one or more settable options in the configuration unit to reflect environmental settings of the particular data source system.

34. The method claimed in claim 30, wherein the step of providing parameters in one or more connectors comprises the step of providing extraction transformation loading (ETL) software code.

35. The method claimed in claim 30, wherein the step of providing parameters in one or more connectors comprises steps of:

providing ETL code for extracting values from a data source system to set the placeholders in the data model and to set the parameters in the configuration unit; and

providing ETL code for using the values to extract information from the data source system, transform the data and load the data into the data model.

36. The method claimed in claim 23, wherein the data source systems comprise enterprise resource planning (ERP) systems.

37. The method claimed in claim 23, further comprising the step of providing one or more reports generated based on the analysis performed by the data model.

38. A method of providing a dimensional framework for use as a foundation of a data warehouse system, the method comprising steps of:

providing placeholders in a set of dimensions, the dimensions representing business reference aspects of multiple organizations, a subset of the set of dimensions representing a particular organization; and

providing a configuration unit for setting the placeholders such that the dimensional framework represents the particular organization.

39. A computer data signal embodied in a carrier wave and representing sequences of instructions which, when executed by a processor, cause the processor to perform a method for providing a data warehouse system adaptable for multiple organizations, the data warehouse system for managing performance of a particular organization, the method comprising steps of:

providing placeholders in a data model, the data model for storing data representing dimensions and measures applicable for multiple organizations, the placeholders settable such that the data model represents a particular organization; and

providing a configuration unit for setting the placeholders such that the data model represents the particular organization.

40. Computer-readable media for storing instructions or statements for use in the execution in a computer of a method for providing a data warehouse system adaptable for multiple organizations, the data warehouse system for managing performance of a particular organization, the method comprising steps of:

providing placeholders in a data model, the data model for storing data representing dimensions and measures applicable for multiple organizations, the placeholders settable such that the data model represents a particular organization; and

providing a configuration unit for setting the placeholders such that the data model represents the particular organization.

41. A computer program product for use in the execution in a computer of a data warehouse system adaptable for multiple organizations, the data warehouse system for managing performance of a particular organization, the data warehouse system comprising:

a data model for storing data representing dimensions and measures applicable for multiple organizations, the data model having placeholders settable such that the data model represents a particular organization; and

a configuration unit for setting the placeholders such that the data model represents the particular organization.

42. A computer data signal embodied in a carrier wave and representing sequences of instructions which, when executed by a processor, cause the processor to perform a method for providing a dimensional framework for use as a foundation of a data warehouse system adaptable for multiple organizations, the data warehouse system for managing performance of a particular organization the method comprising steps of:

providing placeholders in a set of dimensions, the dimensions representing business reference aspects of multiple organizations, a subset of the set of dimensions representing a particular organization; and

providing a configuration unit for setting the placeholders such that the dimensional framework represents the particular organization.

43. Computer-readable media for storing instructions or statements for use in the execution in a computer of a method for providing a dimensional framework for use as a foundation of a data warehouse system data warehouse system adaptable for multiple organizations, the data warehouse system for managing performance of a particular organization the method comprising steps of:

providing placeholders in a set of dimensions, the dimensions representing business reference aspects of multiple organizations, a subset of the set of dimensions representing a particular organization; and

providing a configuration unit for setting the placeholders such that the dimensional framework represents the particular organization.

44. A computer program product for use in the execution in a computer of a dimensional framework for use as a foundation of a data warehouse system adaptable for multiple organizations, the data warehouse system for managing performance of a particular organization, the data warehouse system comprising a set of dimensions representing business reference aspects of multiple organizations, a subset of the set of dimensions representing the business reference aspects of a particular organization, the dimensions having placeholders settable set such that the dimensional framework represents the particular organization.

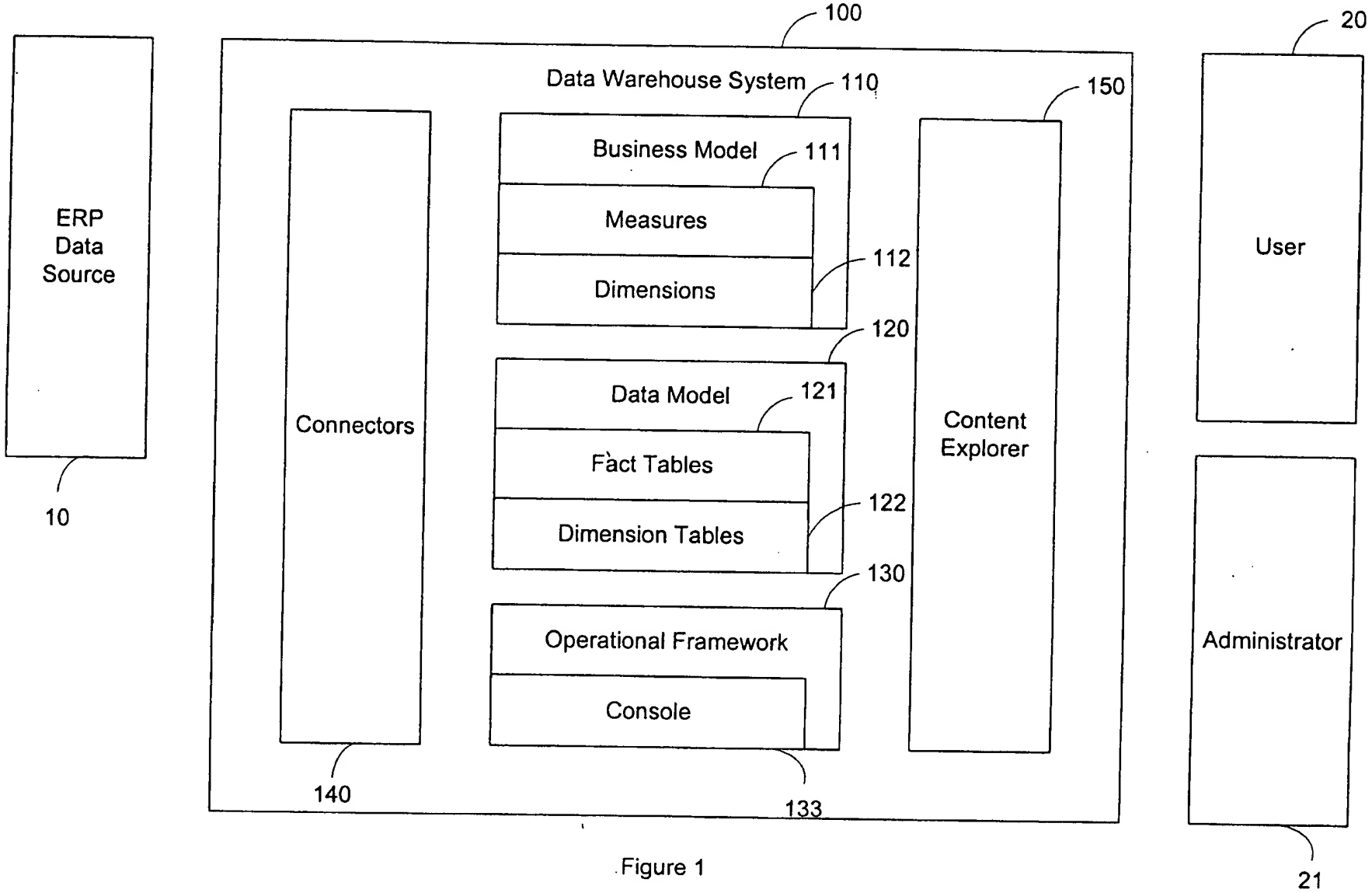


Figure 1

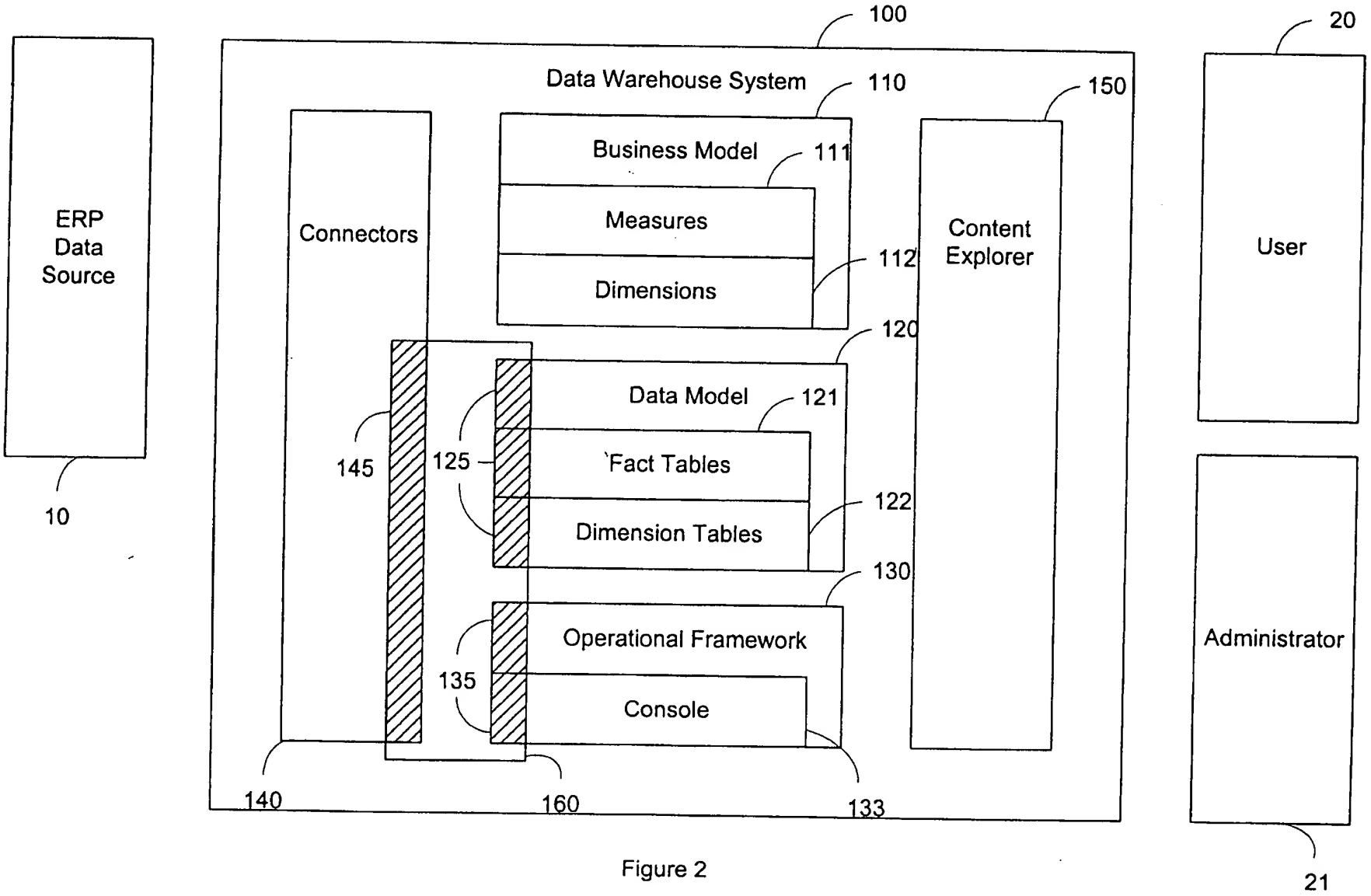


Figure 2

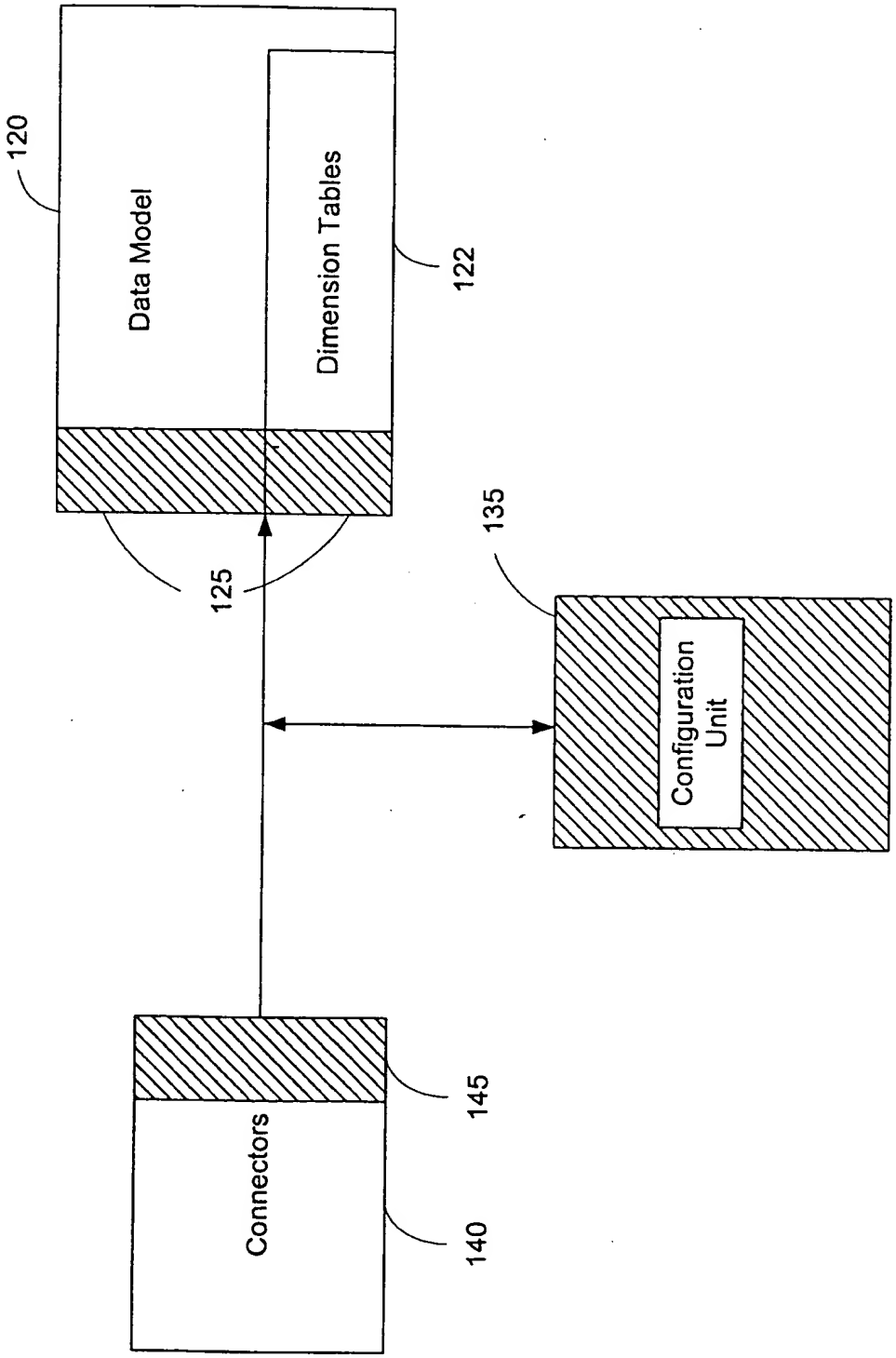

120
Data Model
Dimension Tables
122
125
135
Configuration Unit
145
Connectors
140

Figure 3

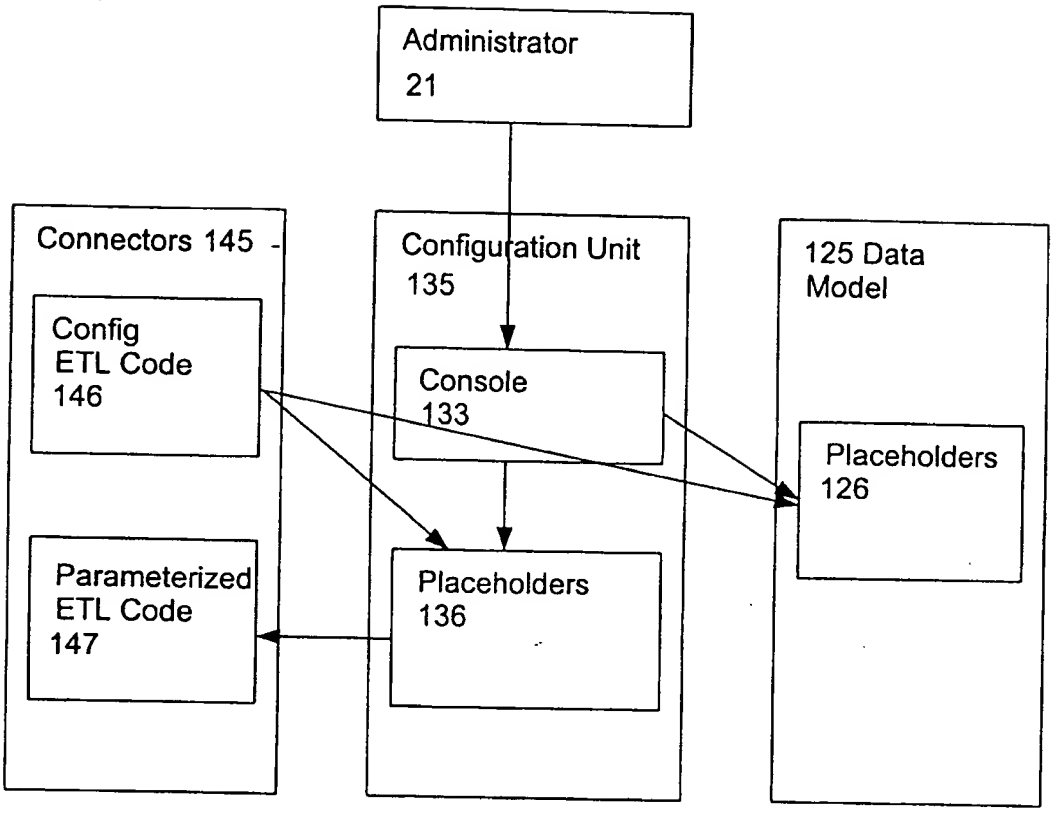

Administrator
21
Connectors 145
Config
ETL Code
146
Parameterized
ETL Code
147
Configuration Unit
135
Console
133
Placeholders
136
125 Data
Model
Placeholders
126

Figure 4

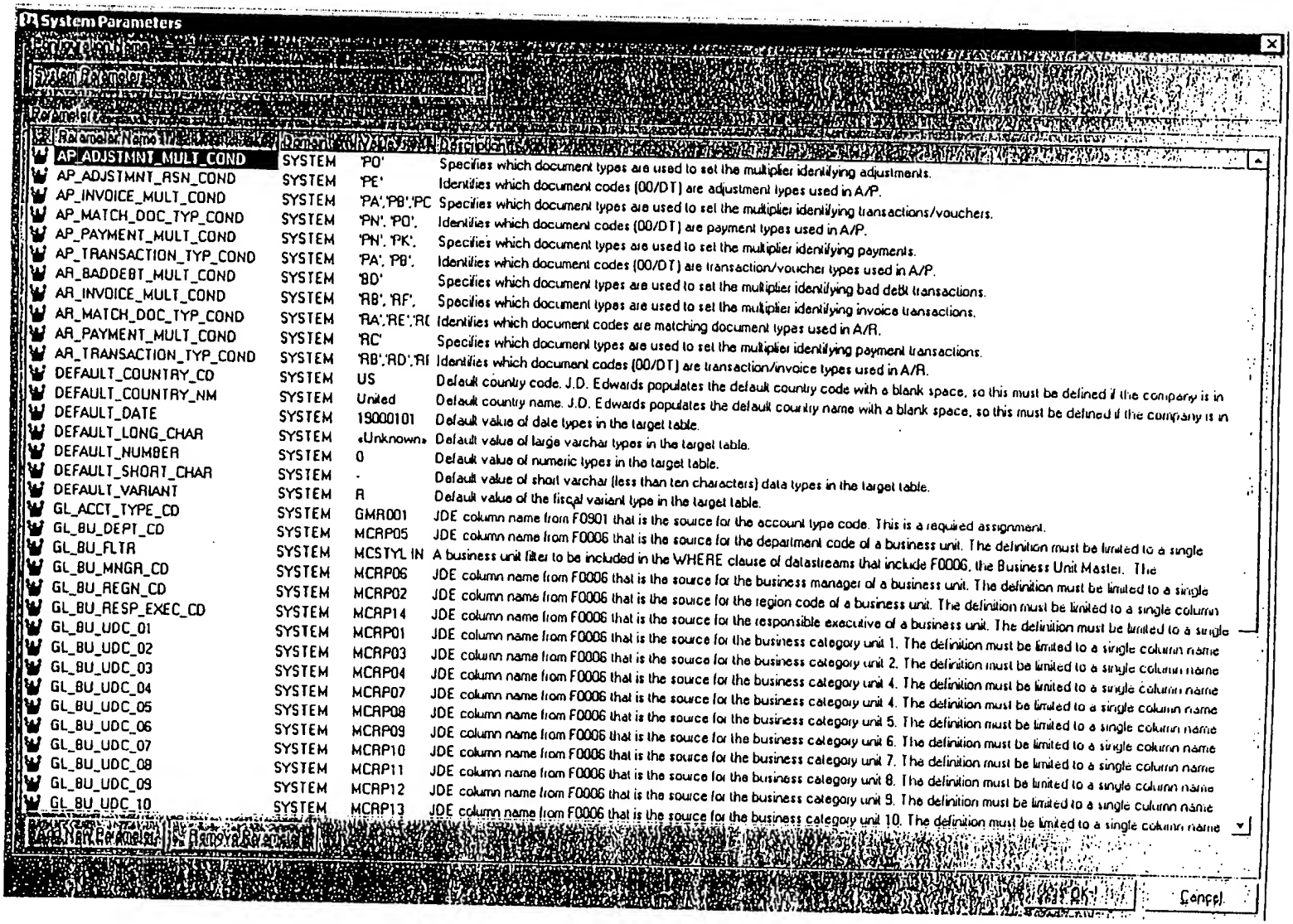


Figure 5

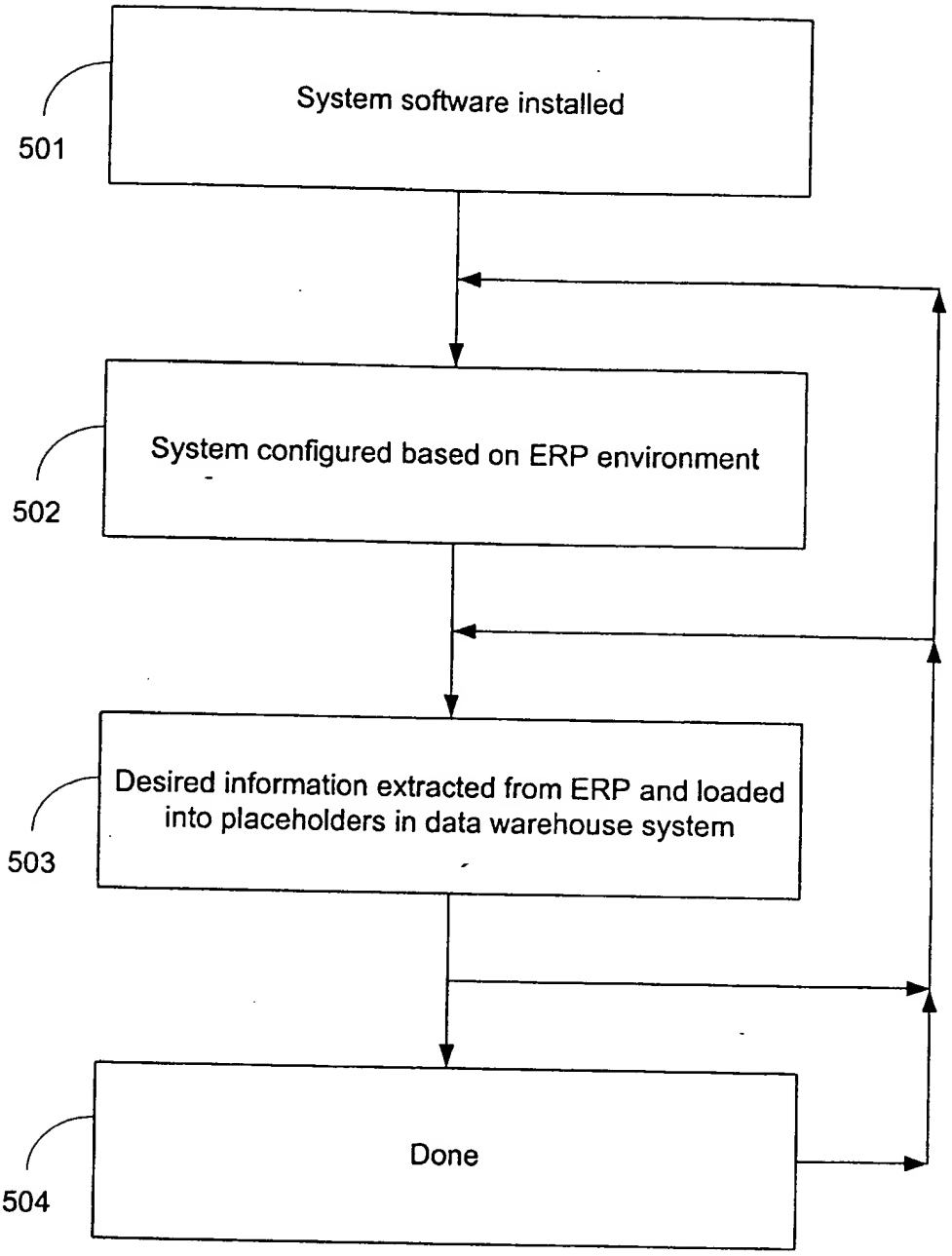

System software installed
501
System configured based on ERP environment
502
Desired information extracted from ERP and loaded into placeholders in data warehouse system
503
Done
504

Figure 6

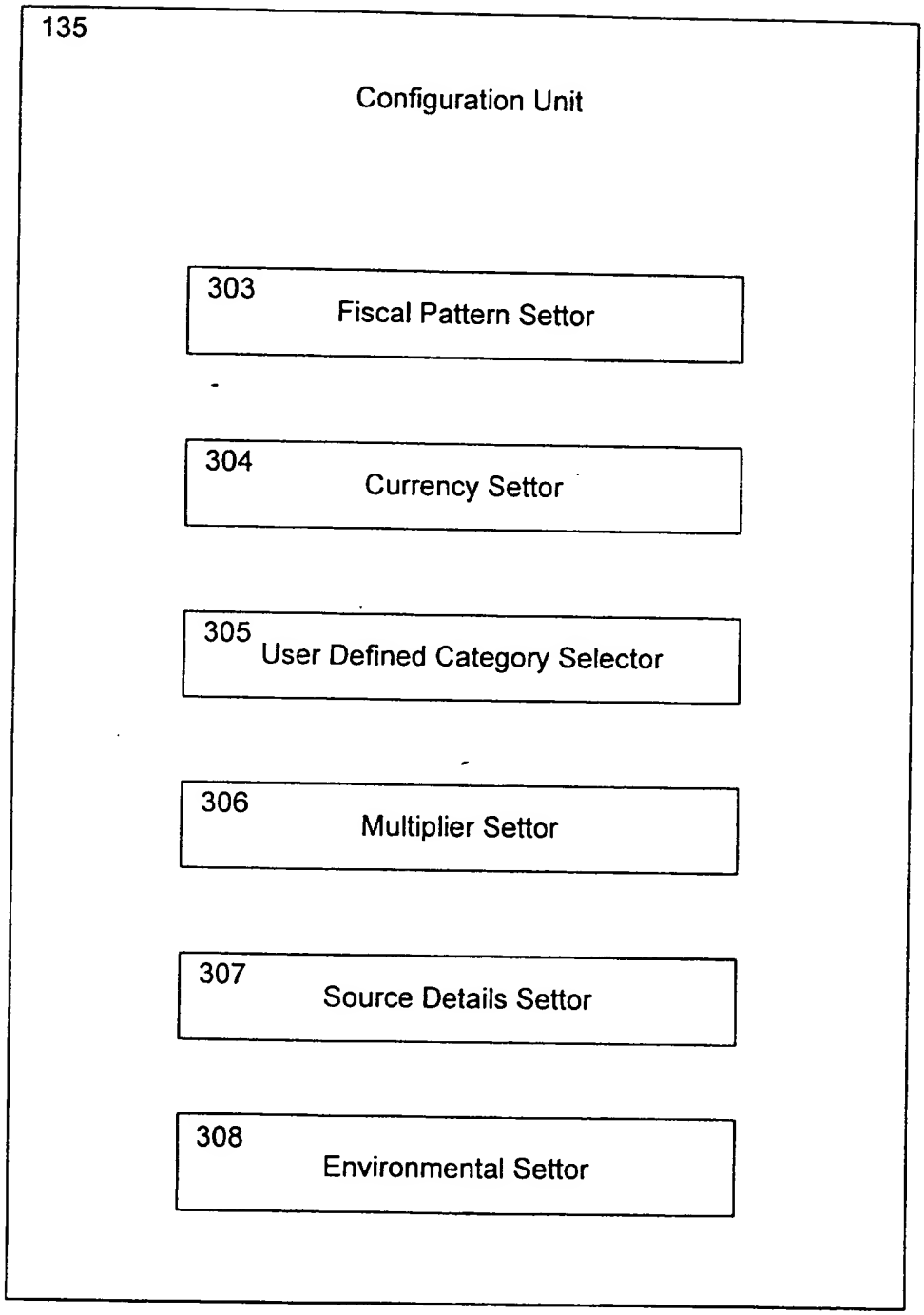

135
Configuration Unit
303
Fiscal Pattern Settor
304
Currency Settor
305
User Defined Category Selector
306
Multiplier Settor
307
Source Details Settor
308
Environmental Settor

Figure 7

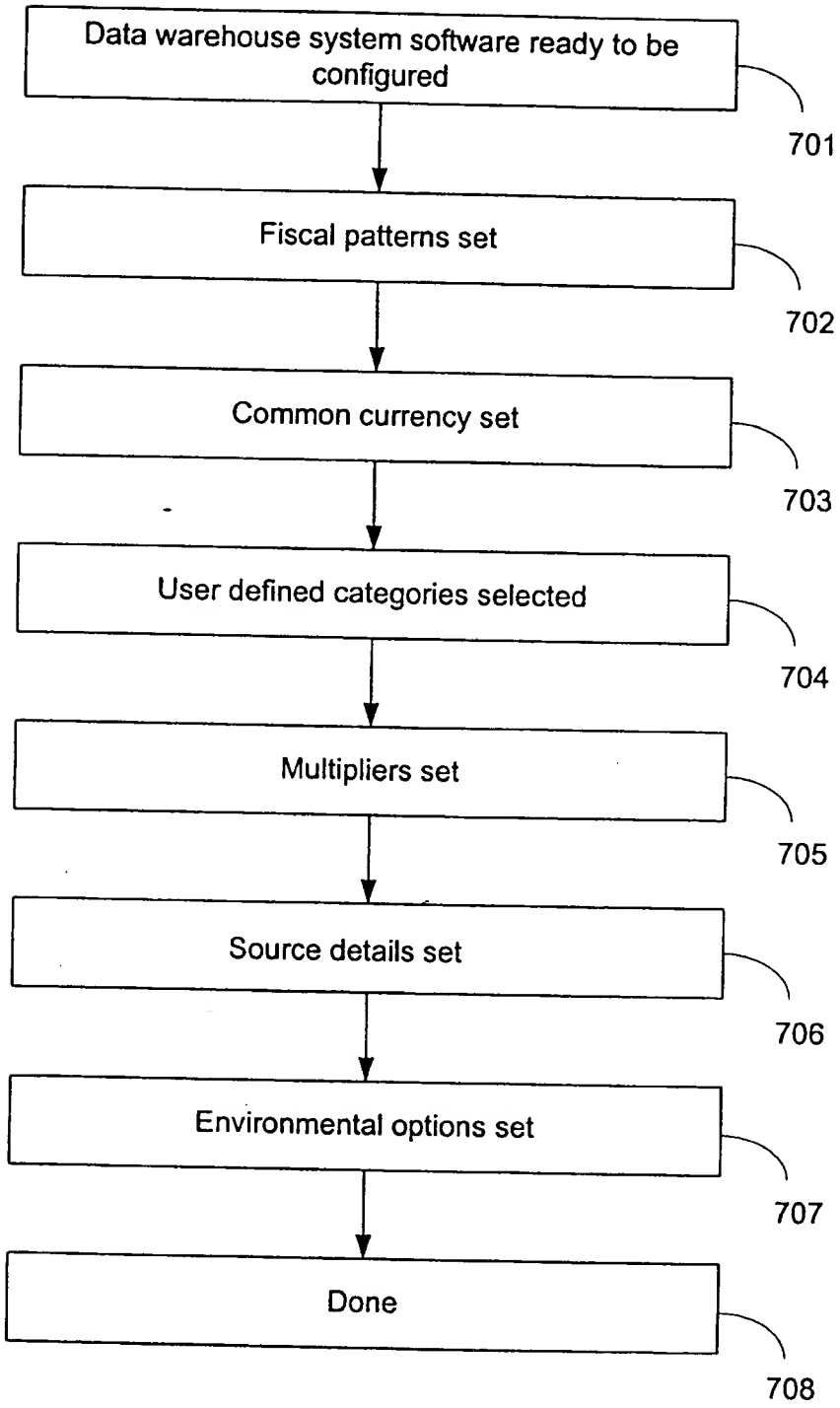

Data warehouse system software ready to be configured
701
Fiscal patterns set
702
Common currency set
703
User defined categories selected
704
Multipliers set
705
Source details set
706
Environmental options set
707
Done
708

Figure 8

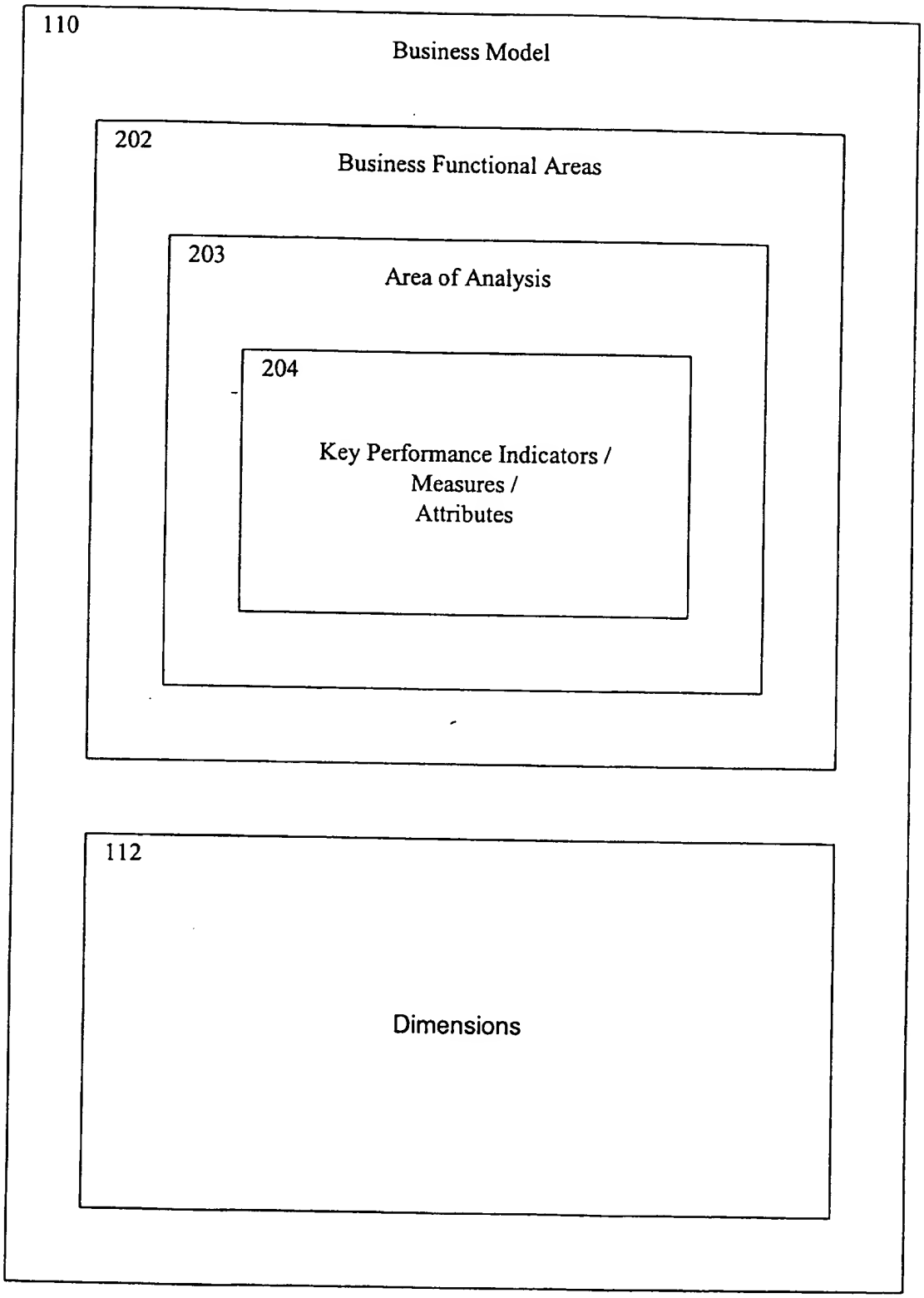

110
Business Model
202
Business Functional Areas
203
Area of Analysis
204
Key Performance Indicators /
Measures /
Attributes
112
Dimensions

Figure 9

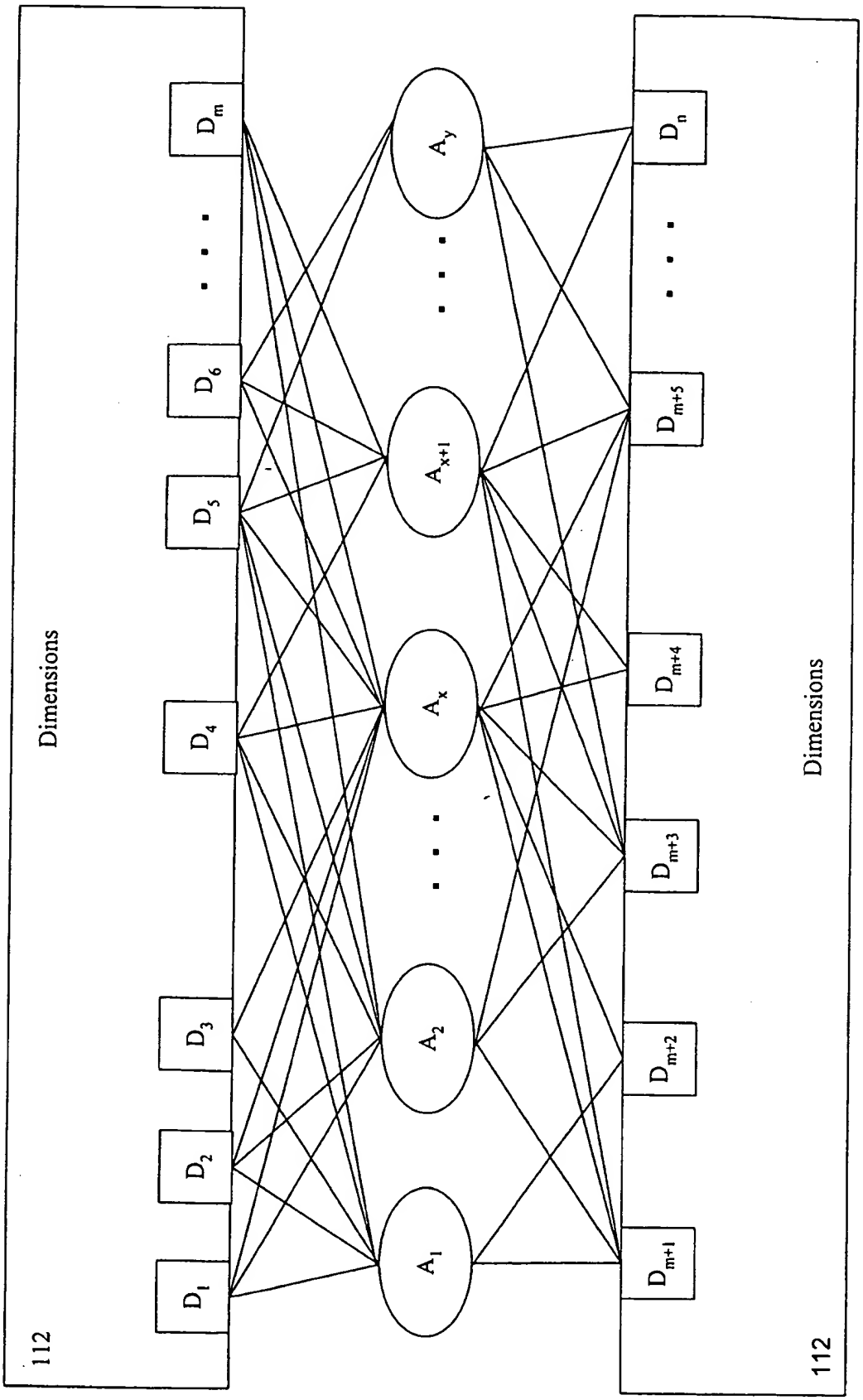

Dimensions
112
D_1
D_2
D_3
D_4
D_5
D_6
D_m
A_1
A_2
A_x
A_{x+1}
A_y
D_{m+1}
D_{m+2}
D_{m+3}
D_{m+4}
D_{m+5}
D_n
Dimensions
112

Figure 10

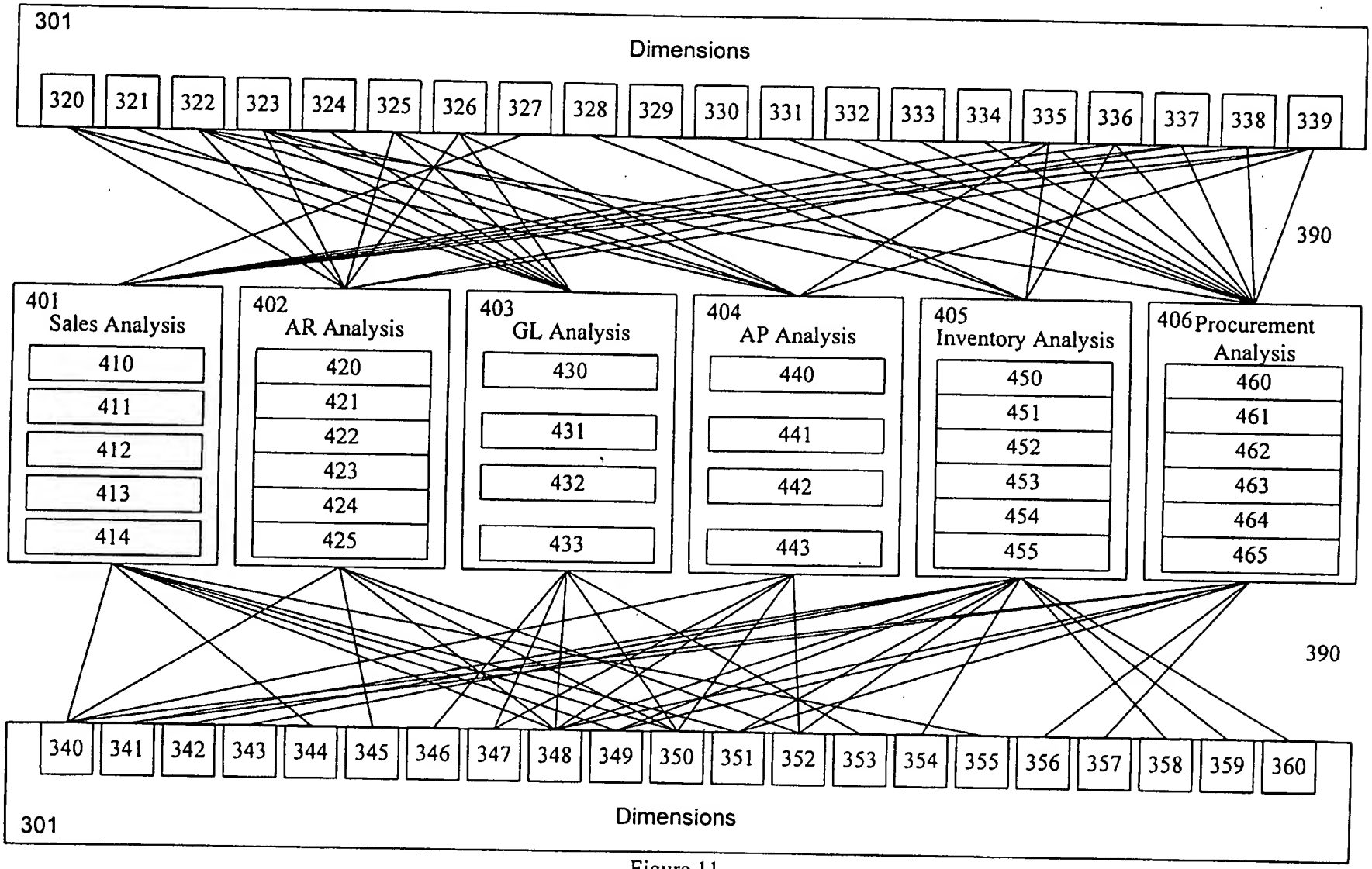


Figure 11

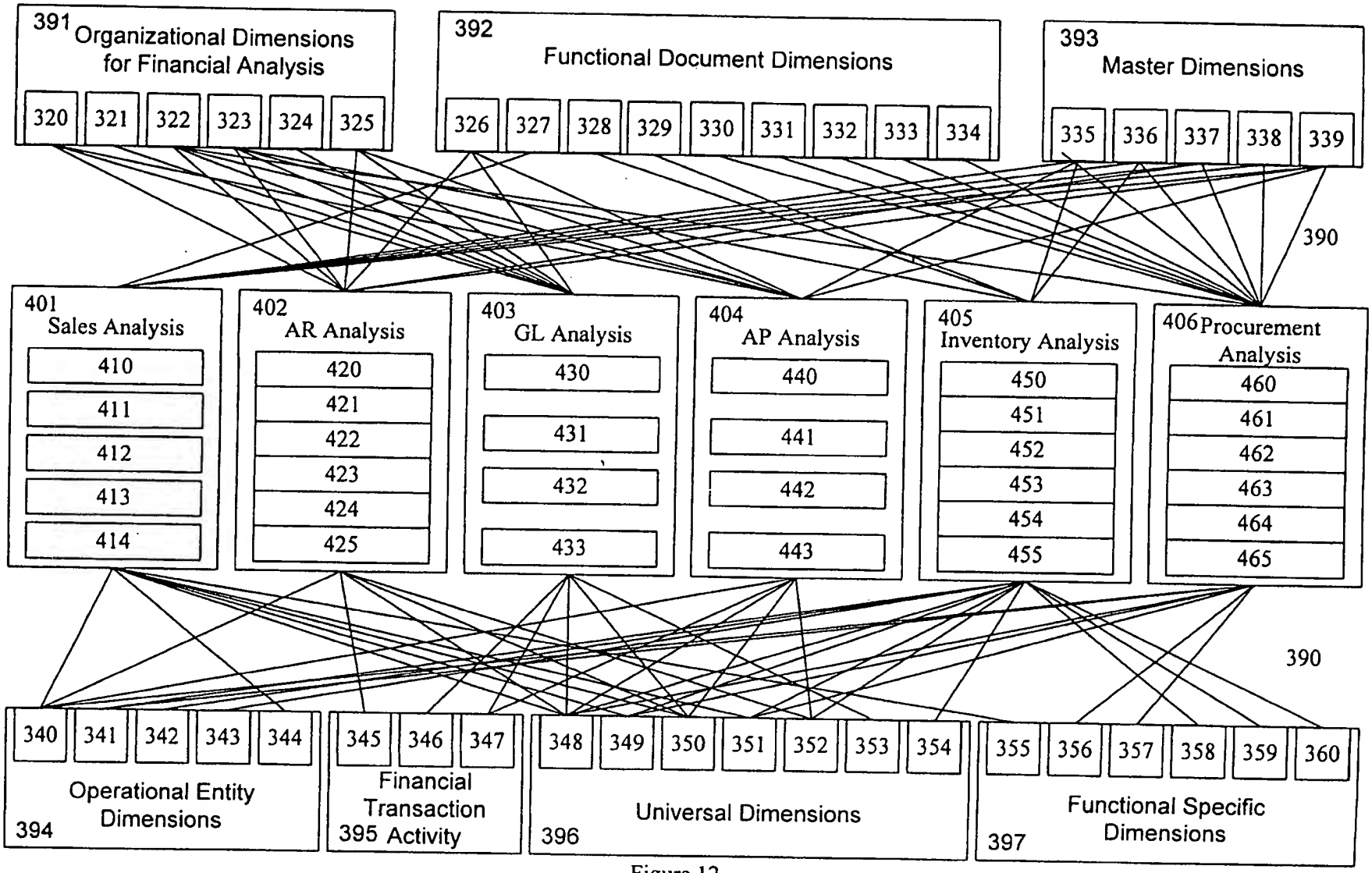
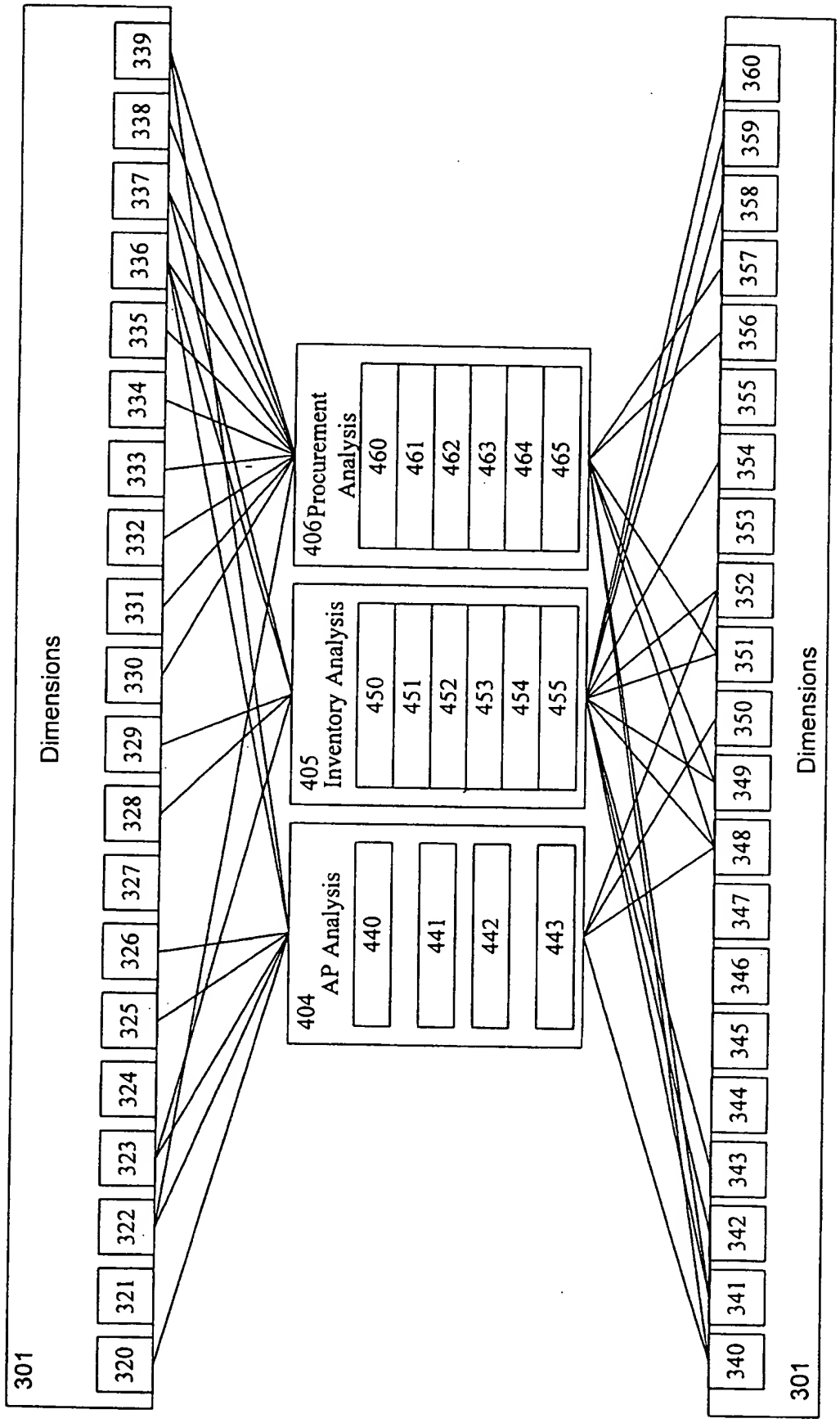


Figure 12


301
Dimensions
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338
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404
AP Analysis
440
441
442
443
405
Inventory Analysis
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Procurement Analysis
460
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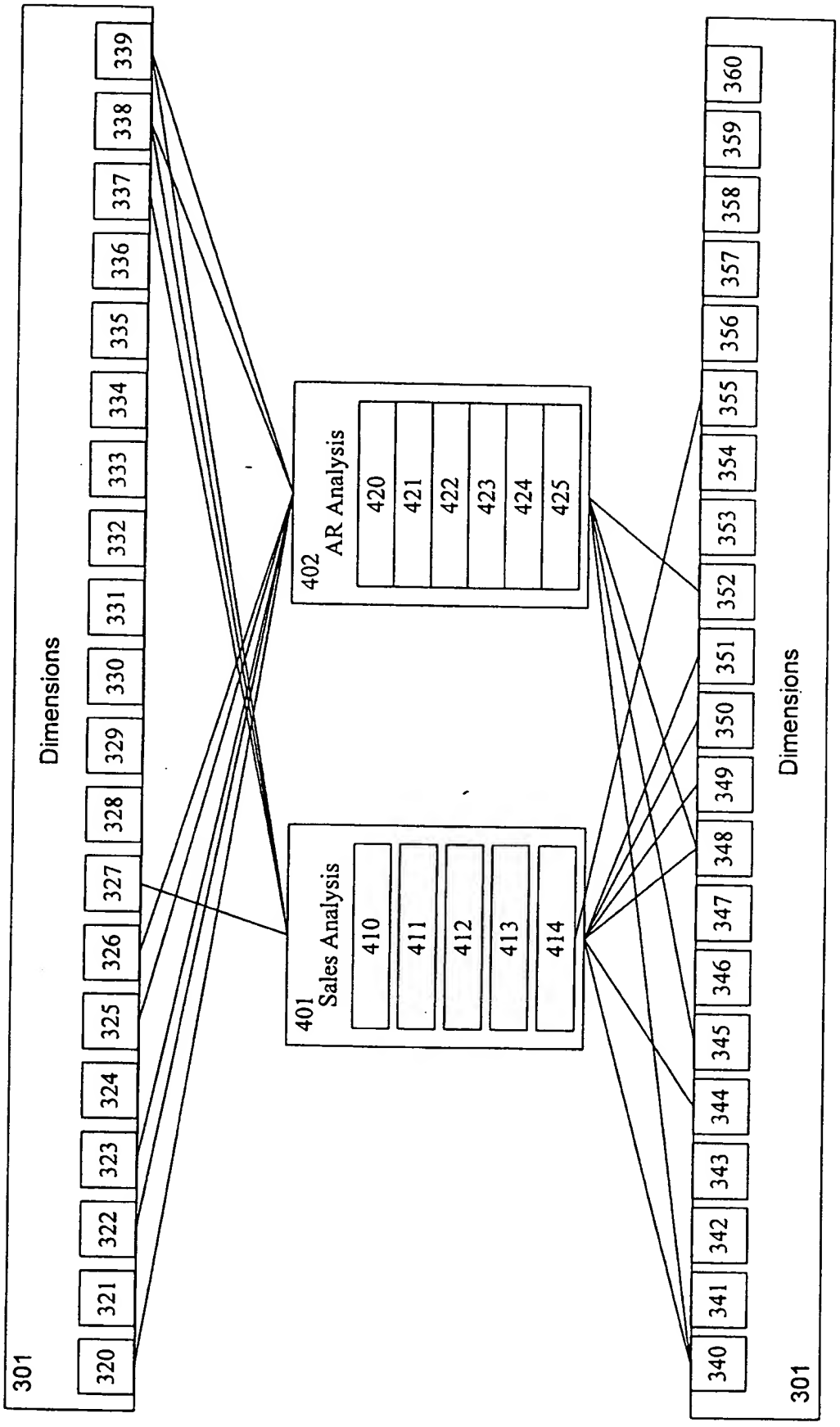
360
Dimensions
301

Figure 13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Dimensions
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401
Sales Analysis
410
411
412
413
414
402
AR Analysis
420
421
422
423
424
425
301
Dimensions
340
341
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Figure 14

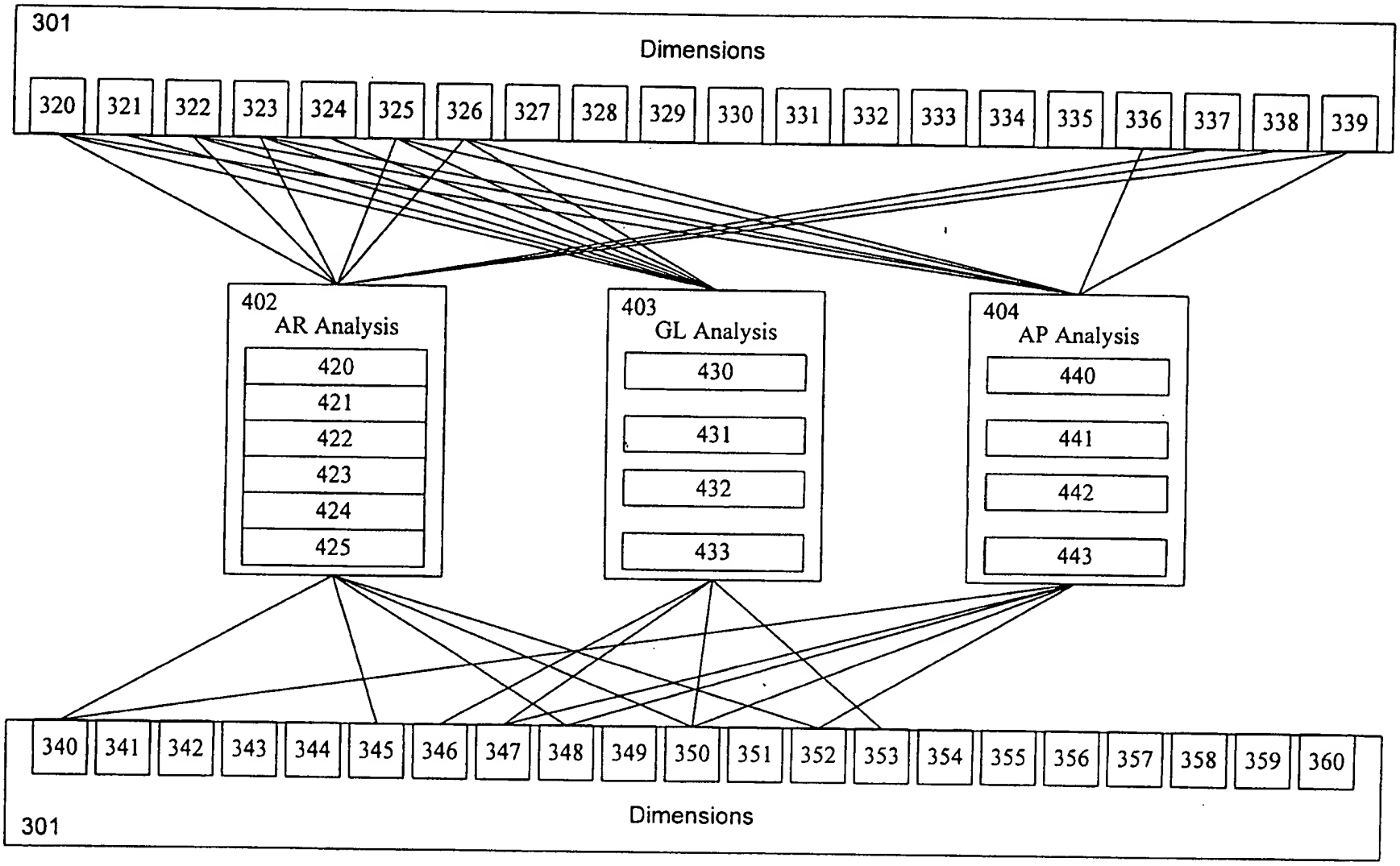


Figure 15

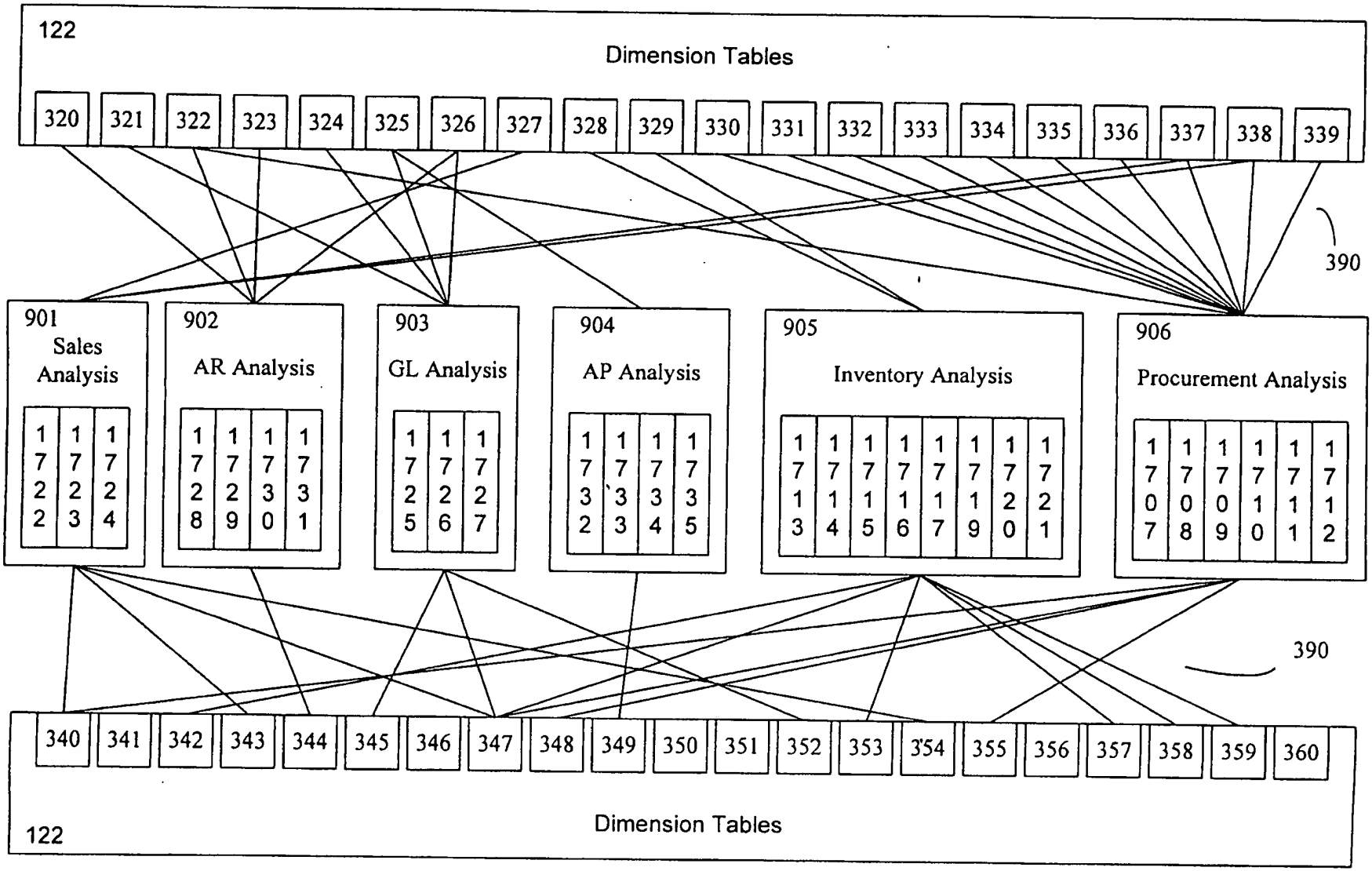


Figure 16

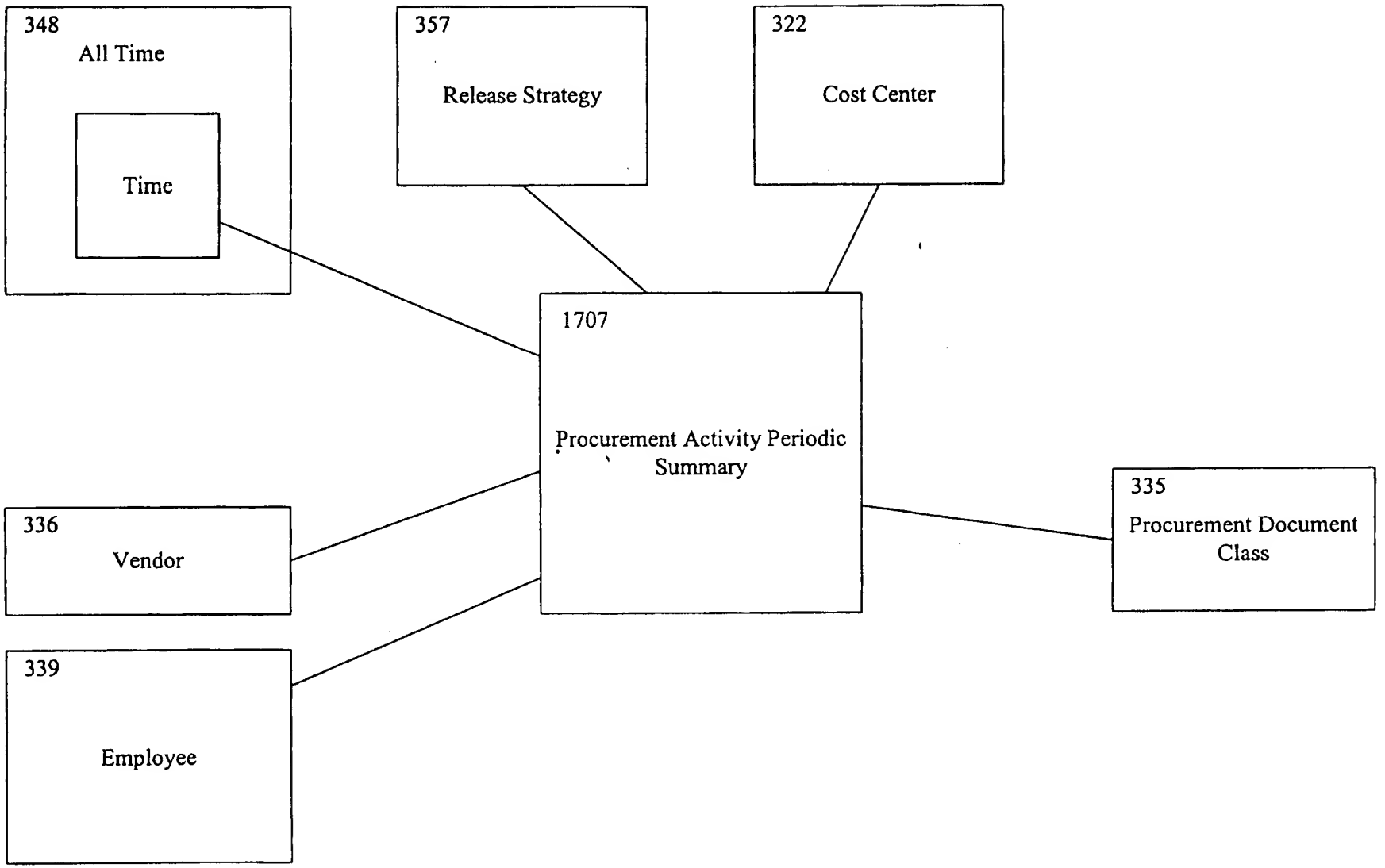


Figure 17A

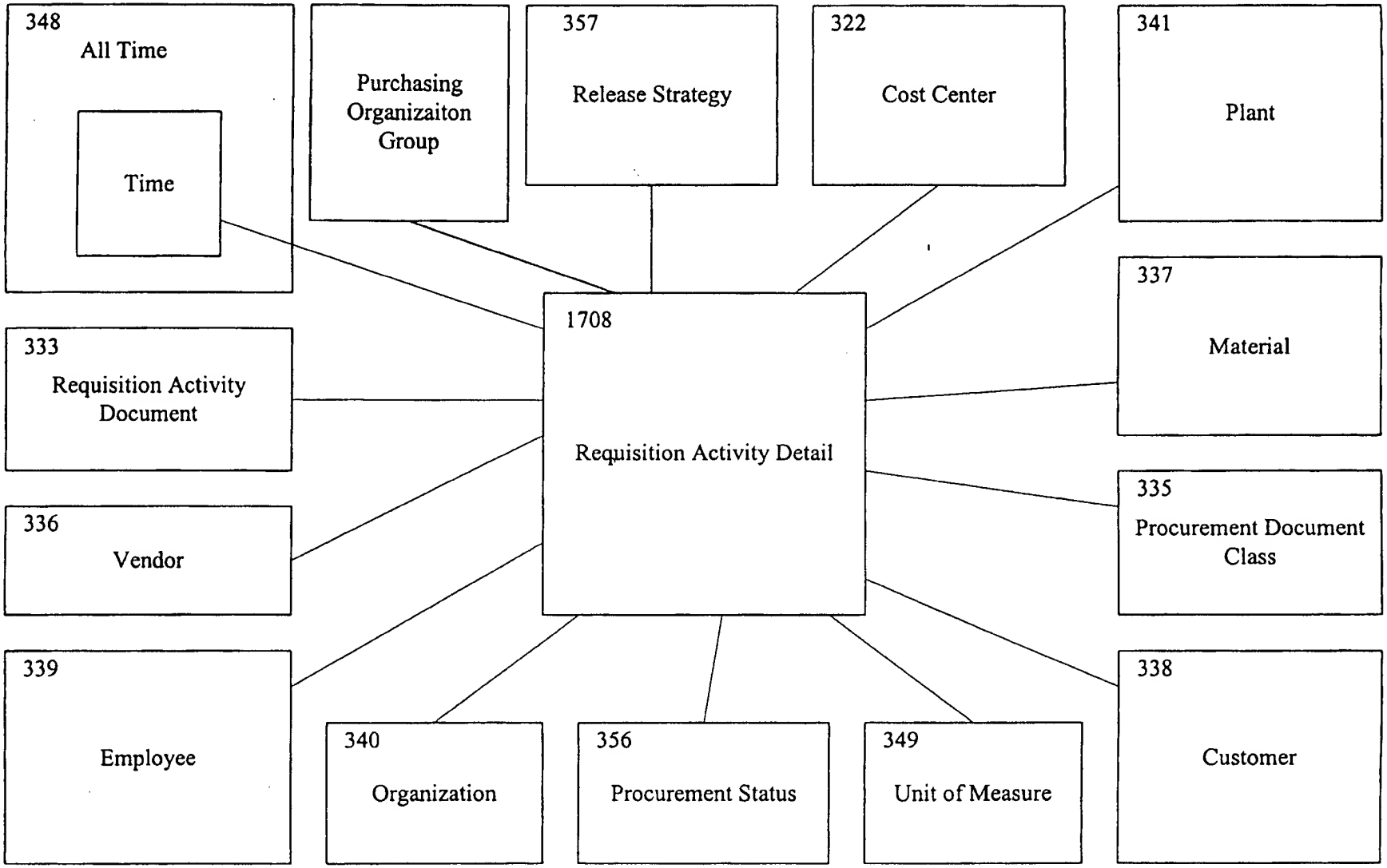


Figure 17B

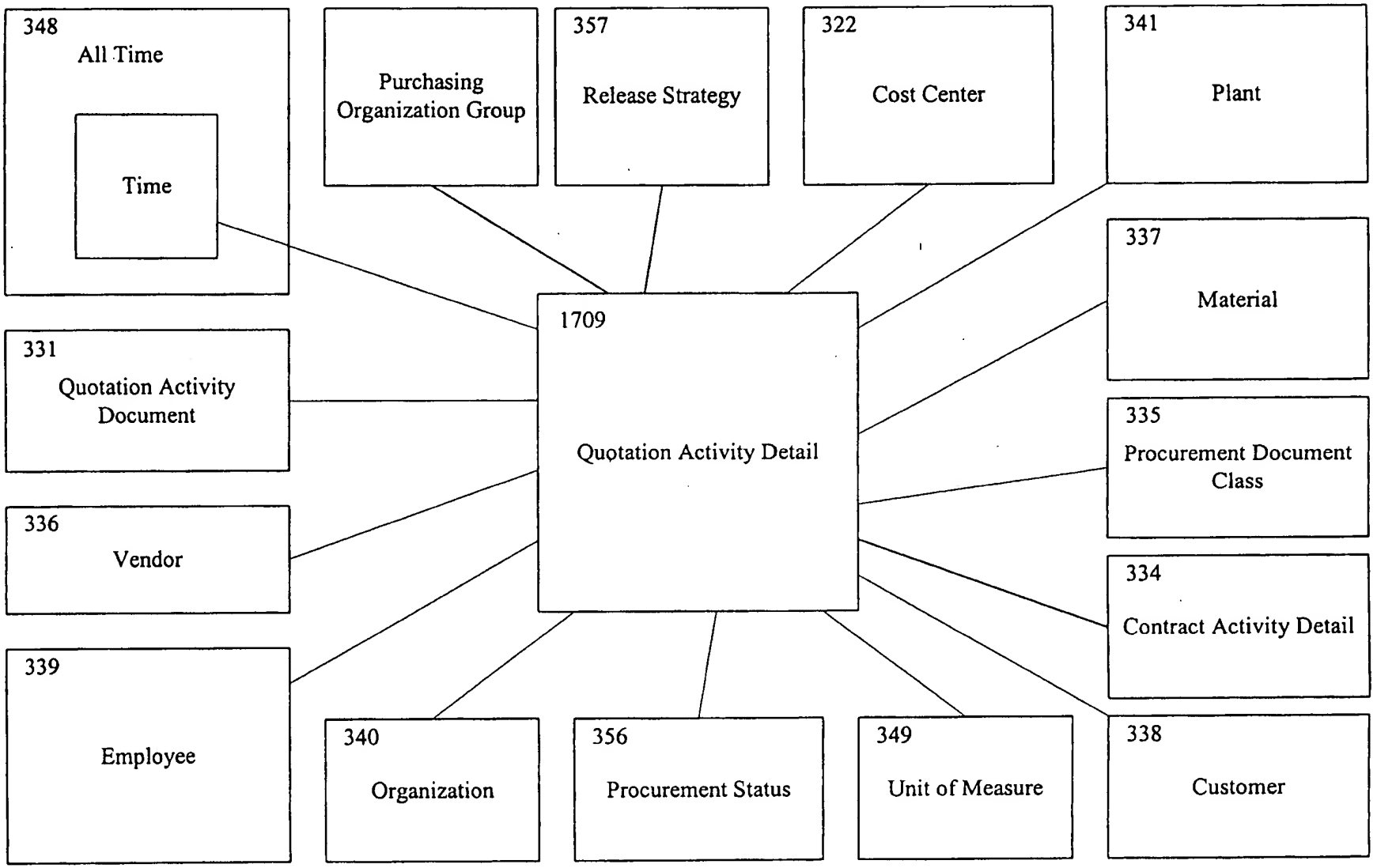


Figure 17C

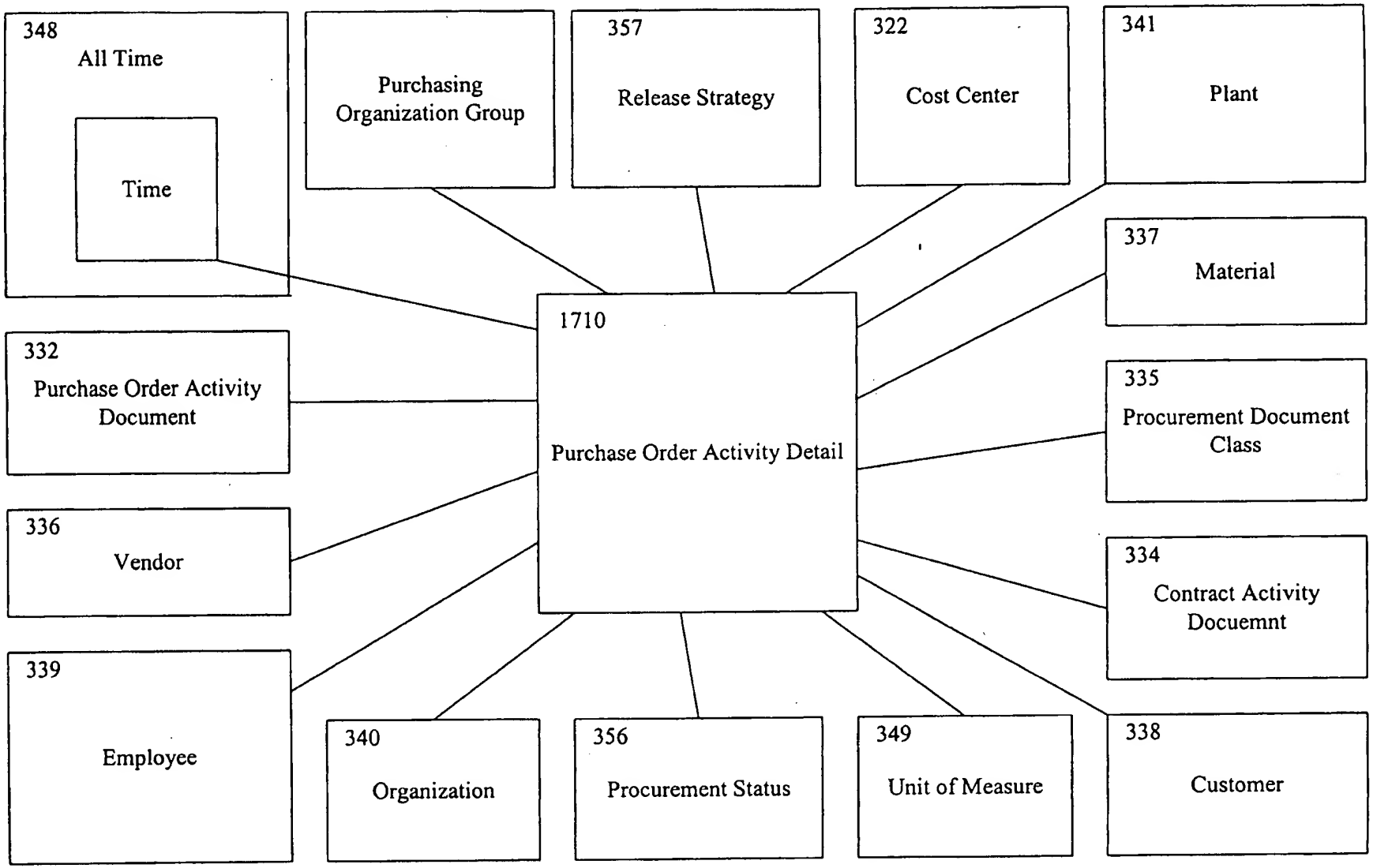


Figure 17D

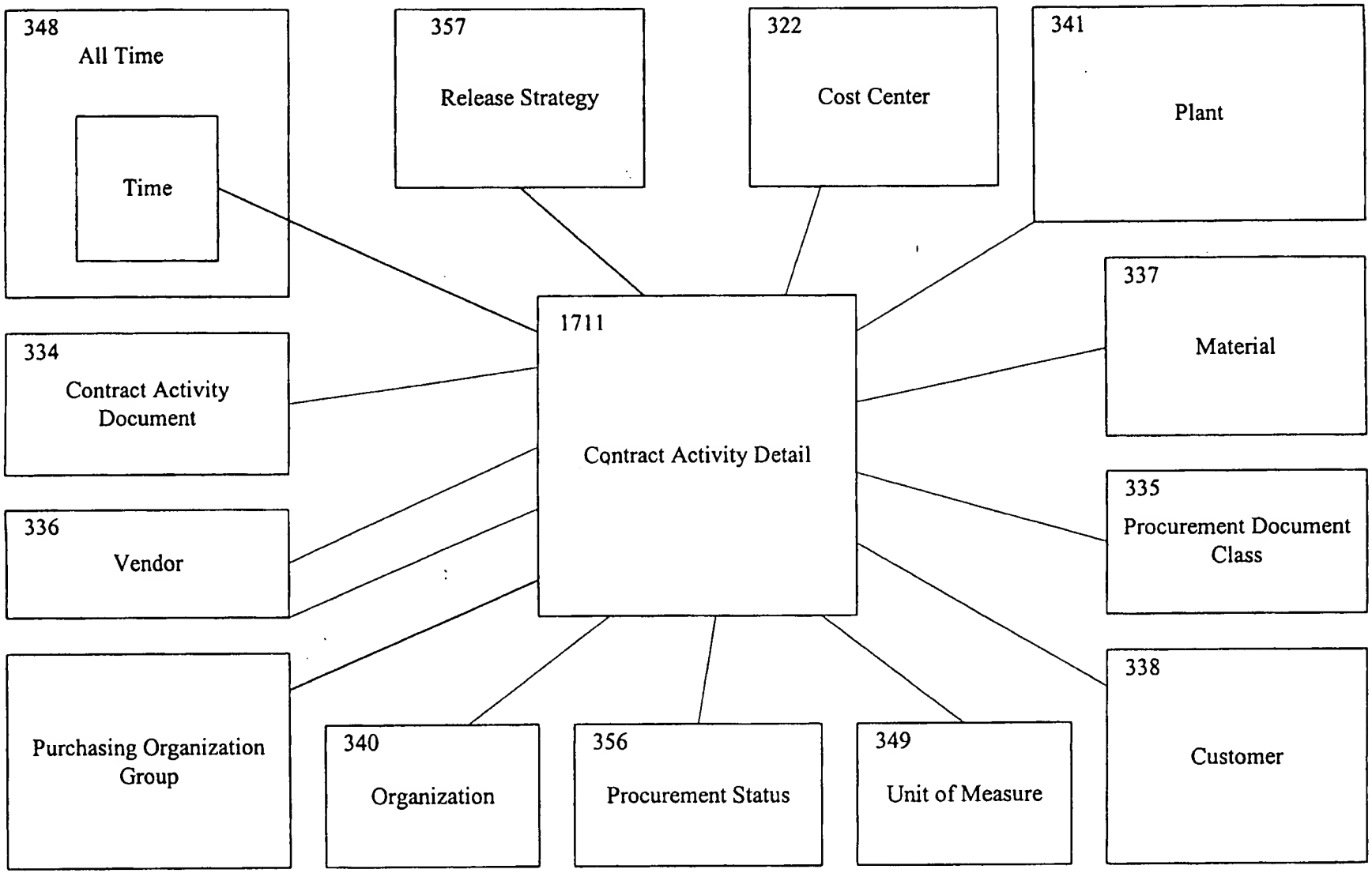


Figure 17E

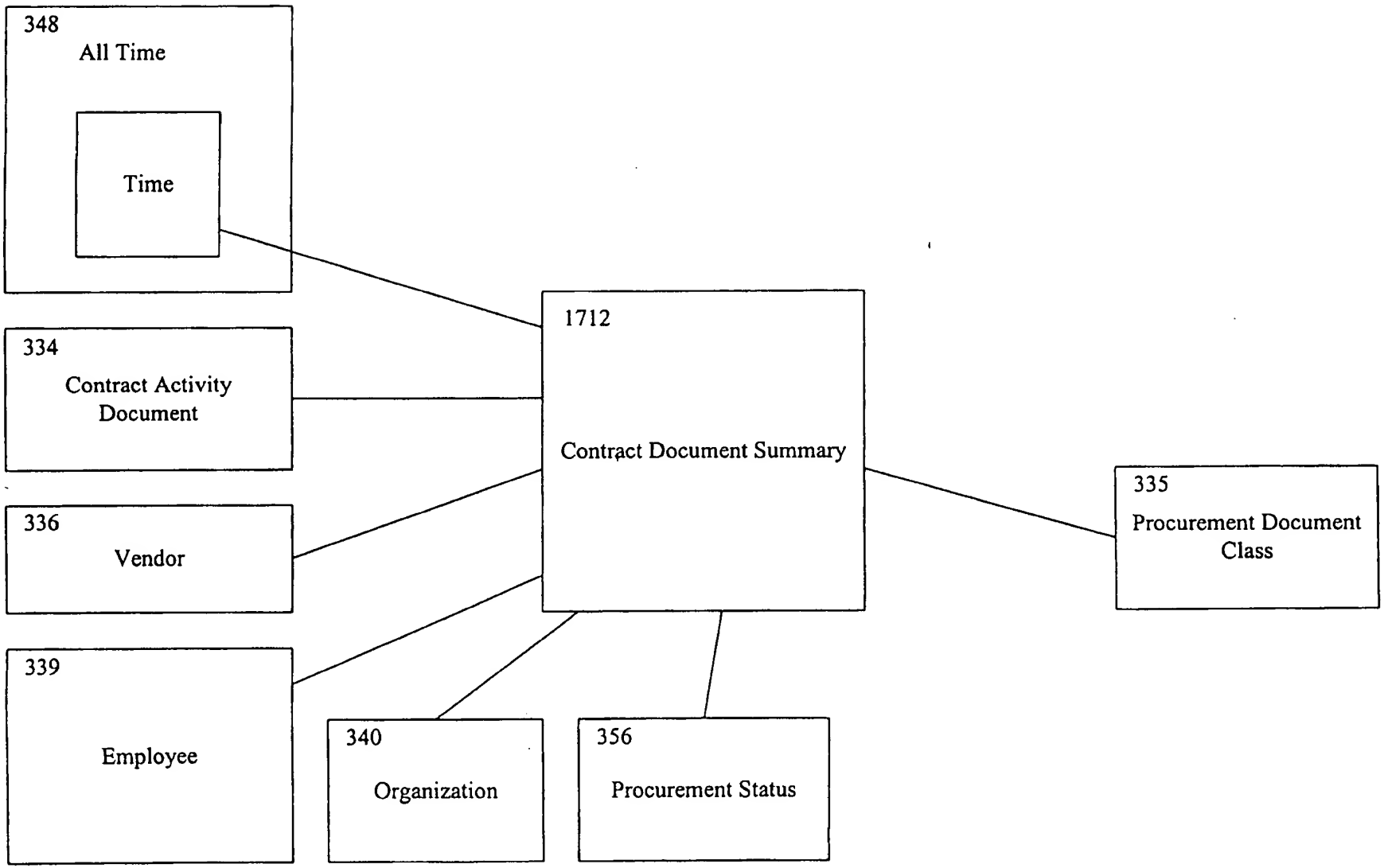


Figure 17F

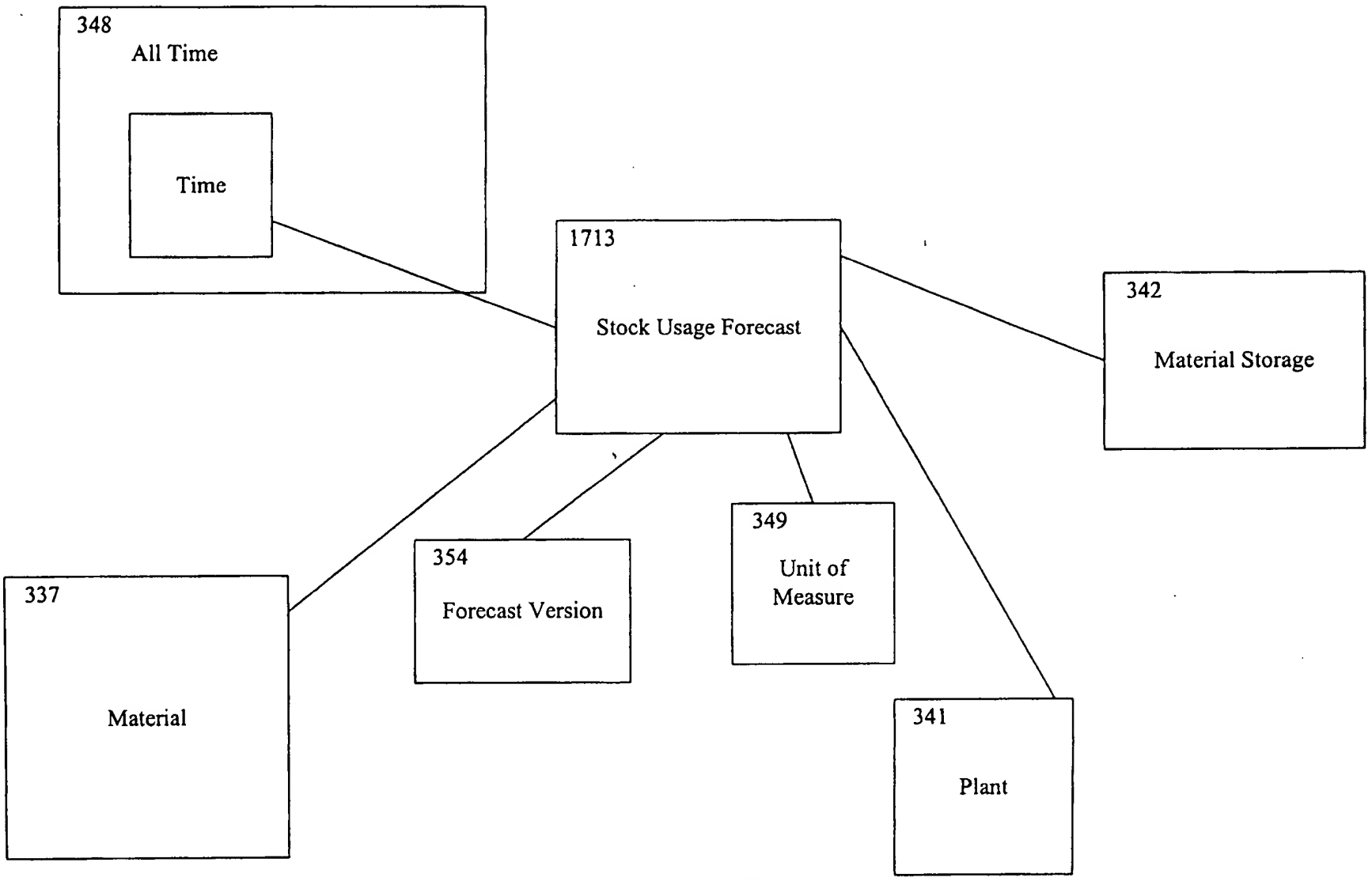


Figure 17G

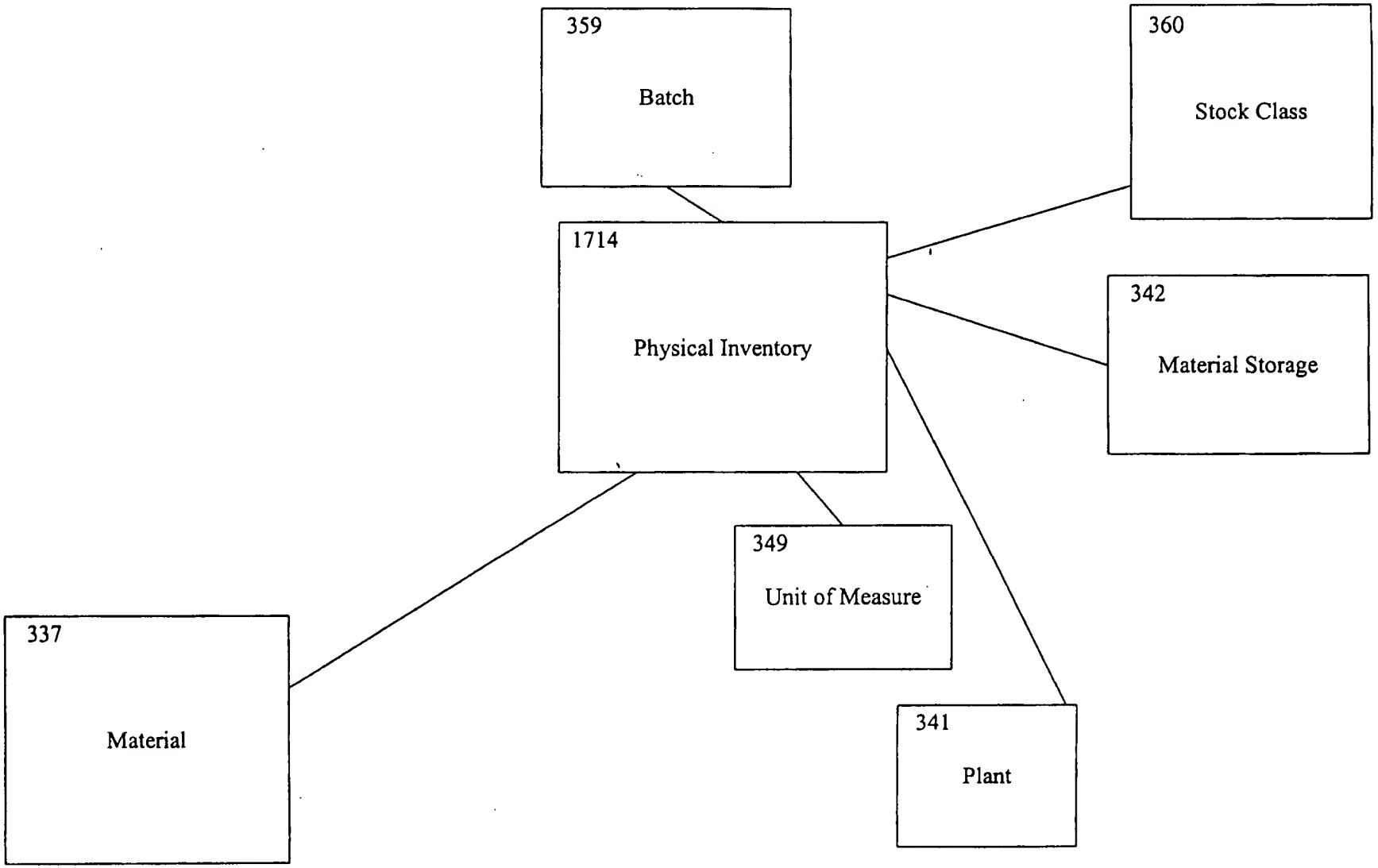


Figure 17H

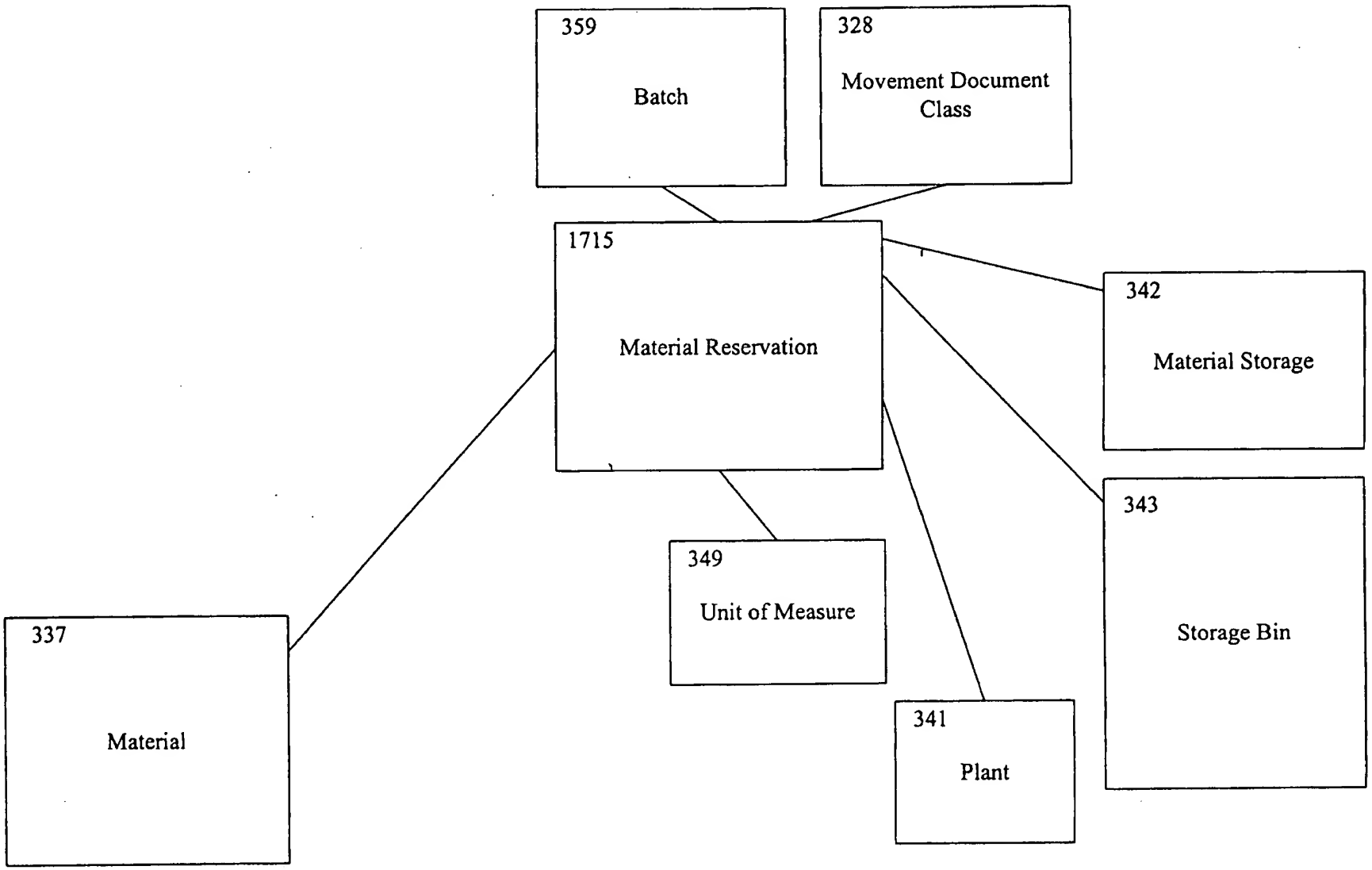


Figure 17I

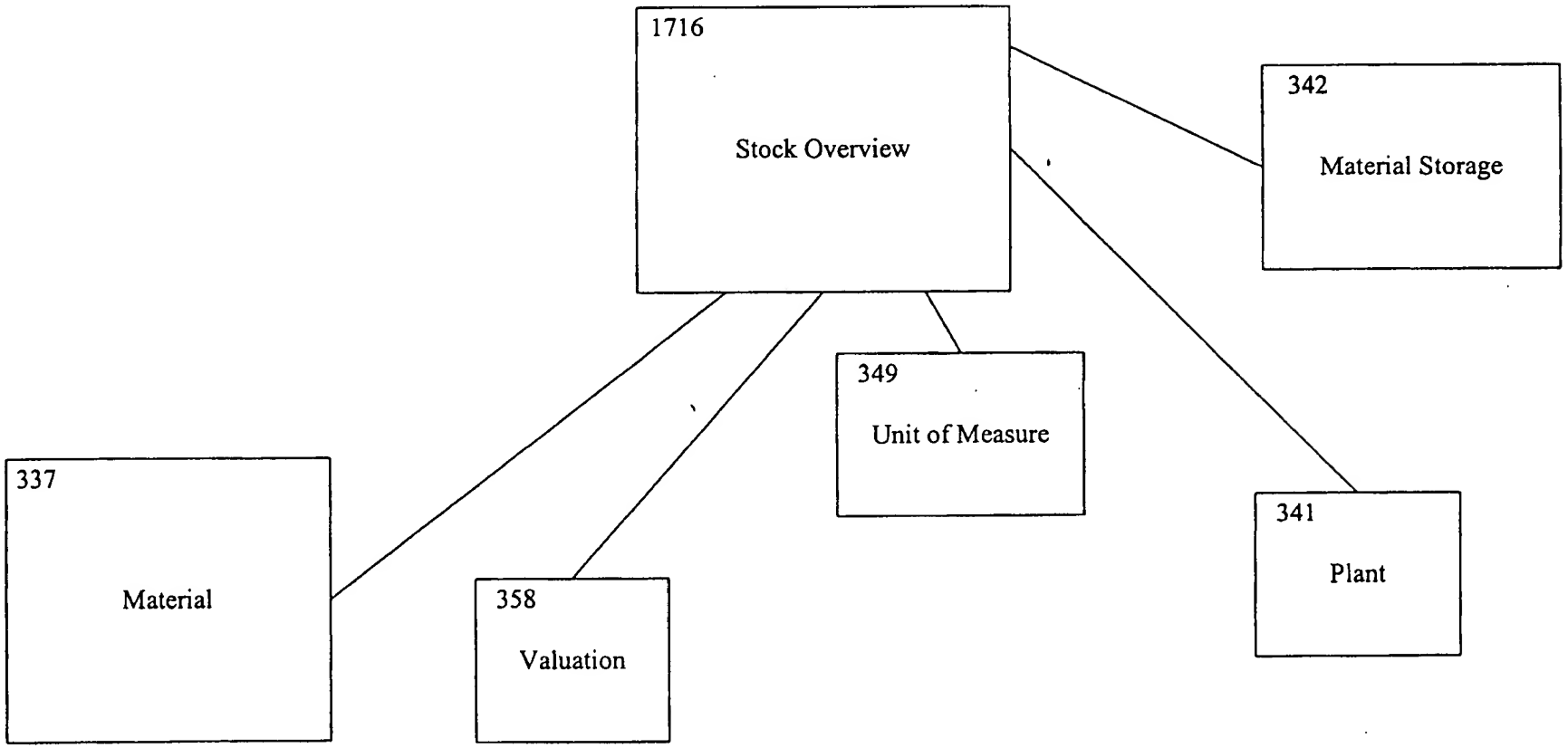


Figure 17J

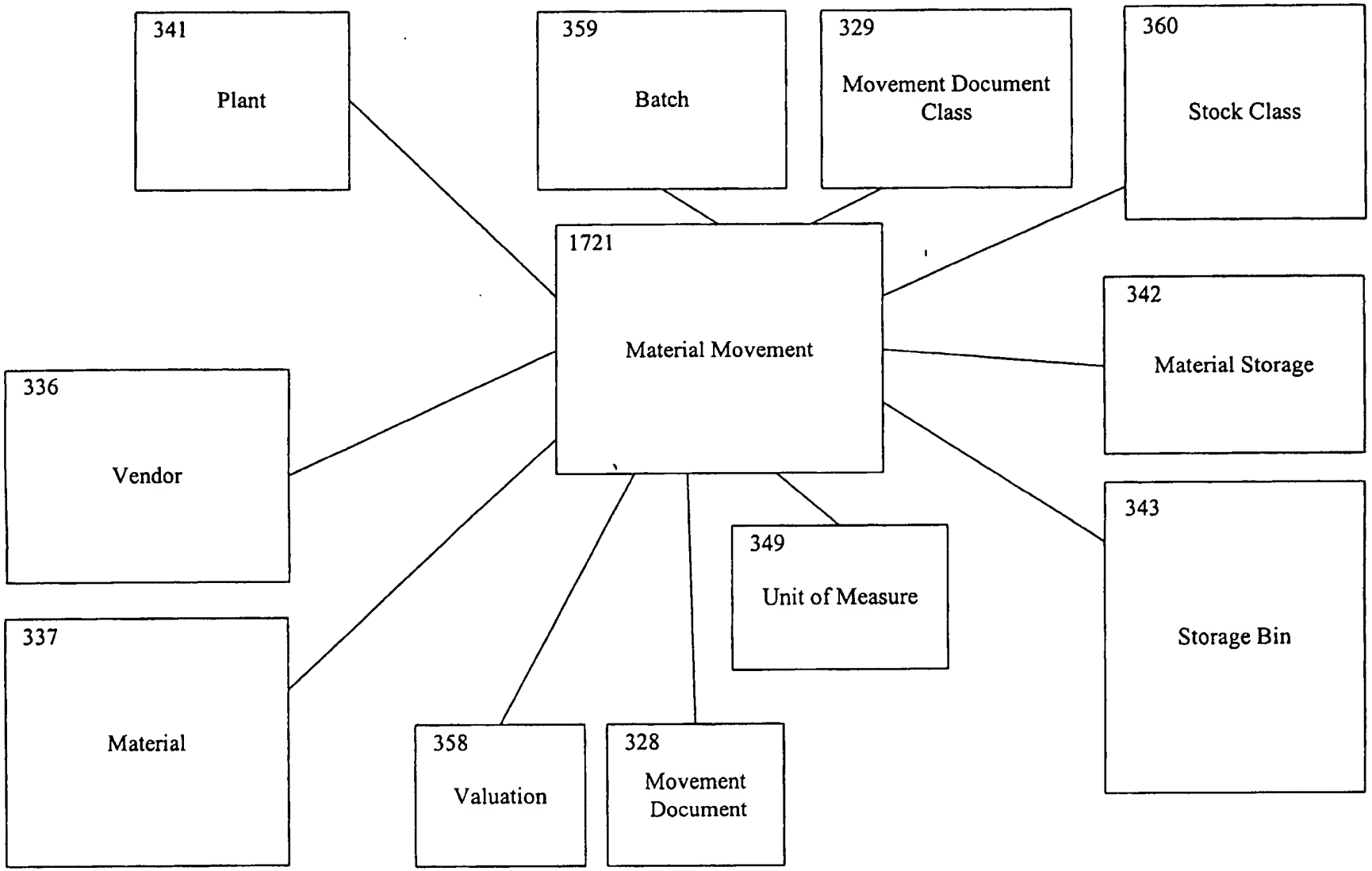


Figure 17K

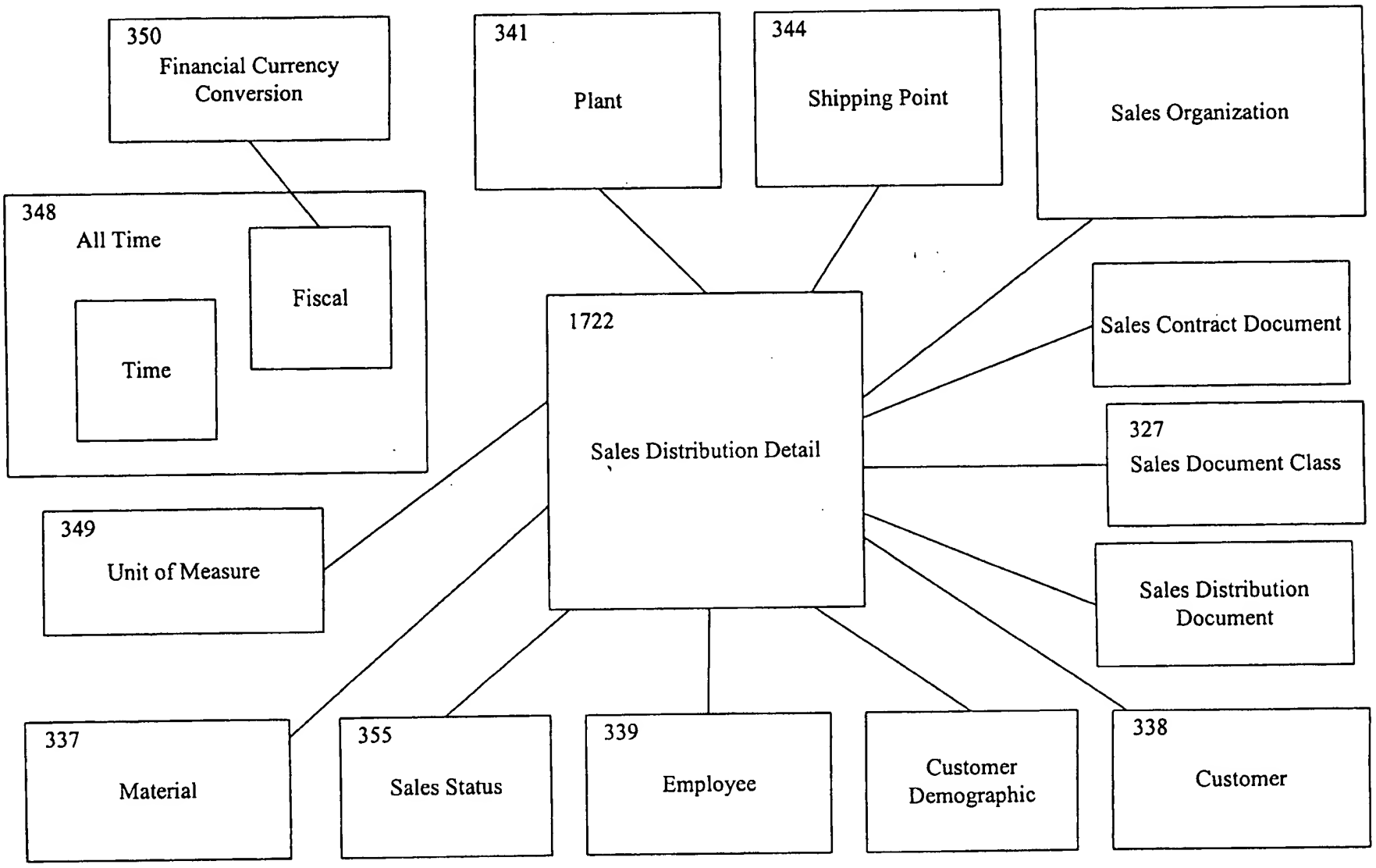


Figure 17L

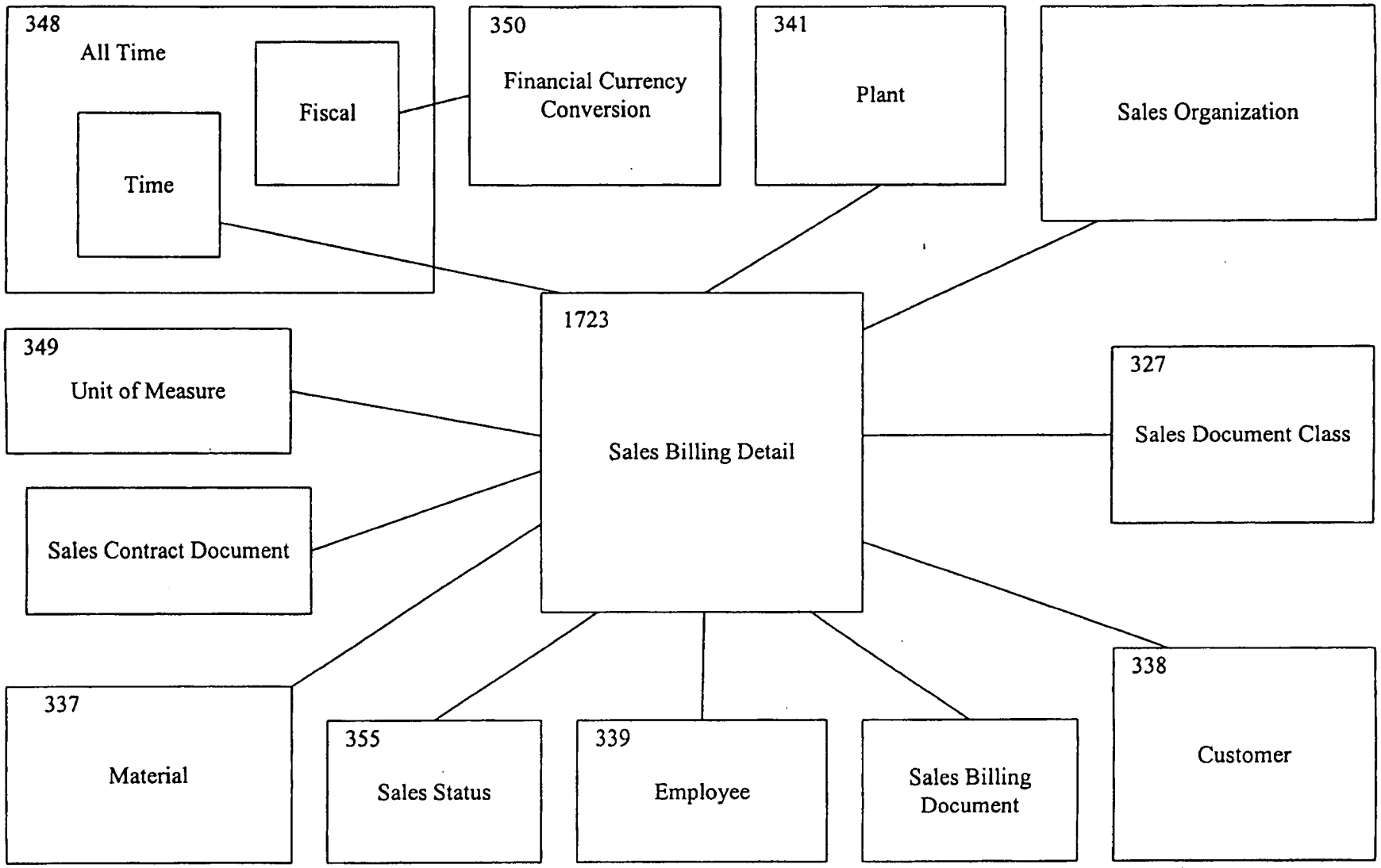


Figure 17M

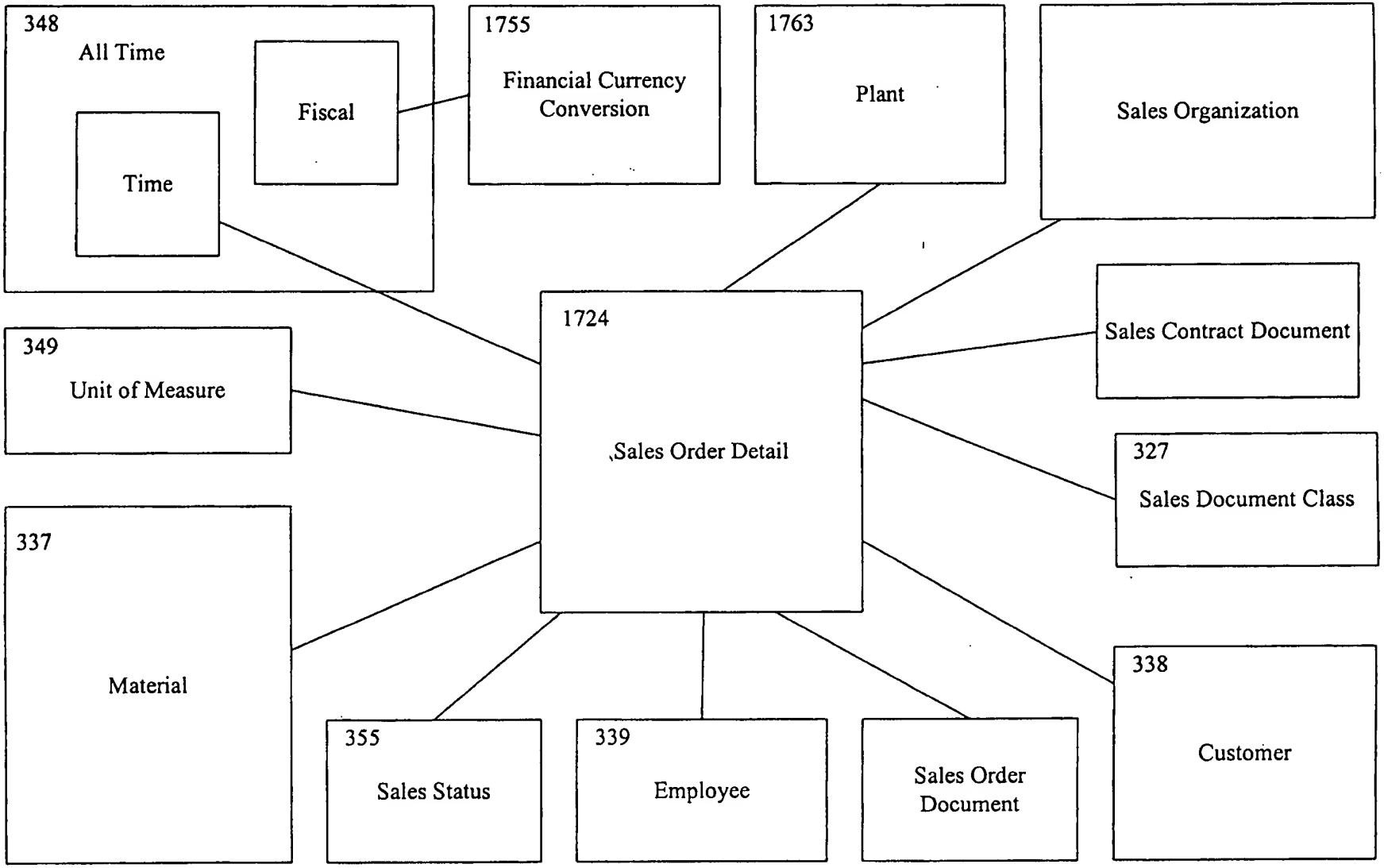


Figure 17N

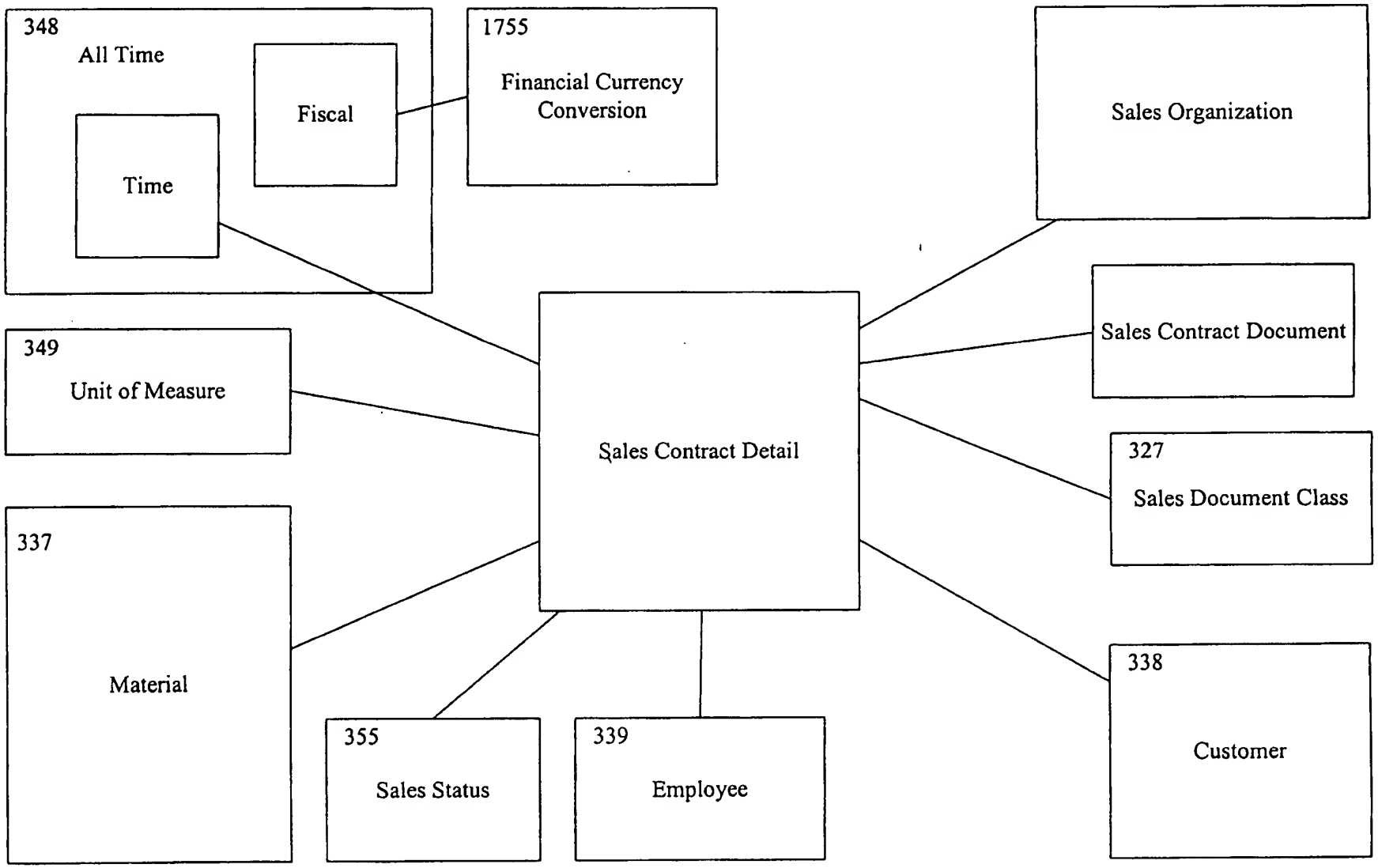


Figure 17O

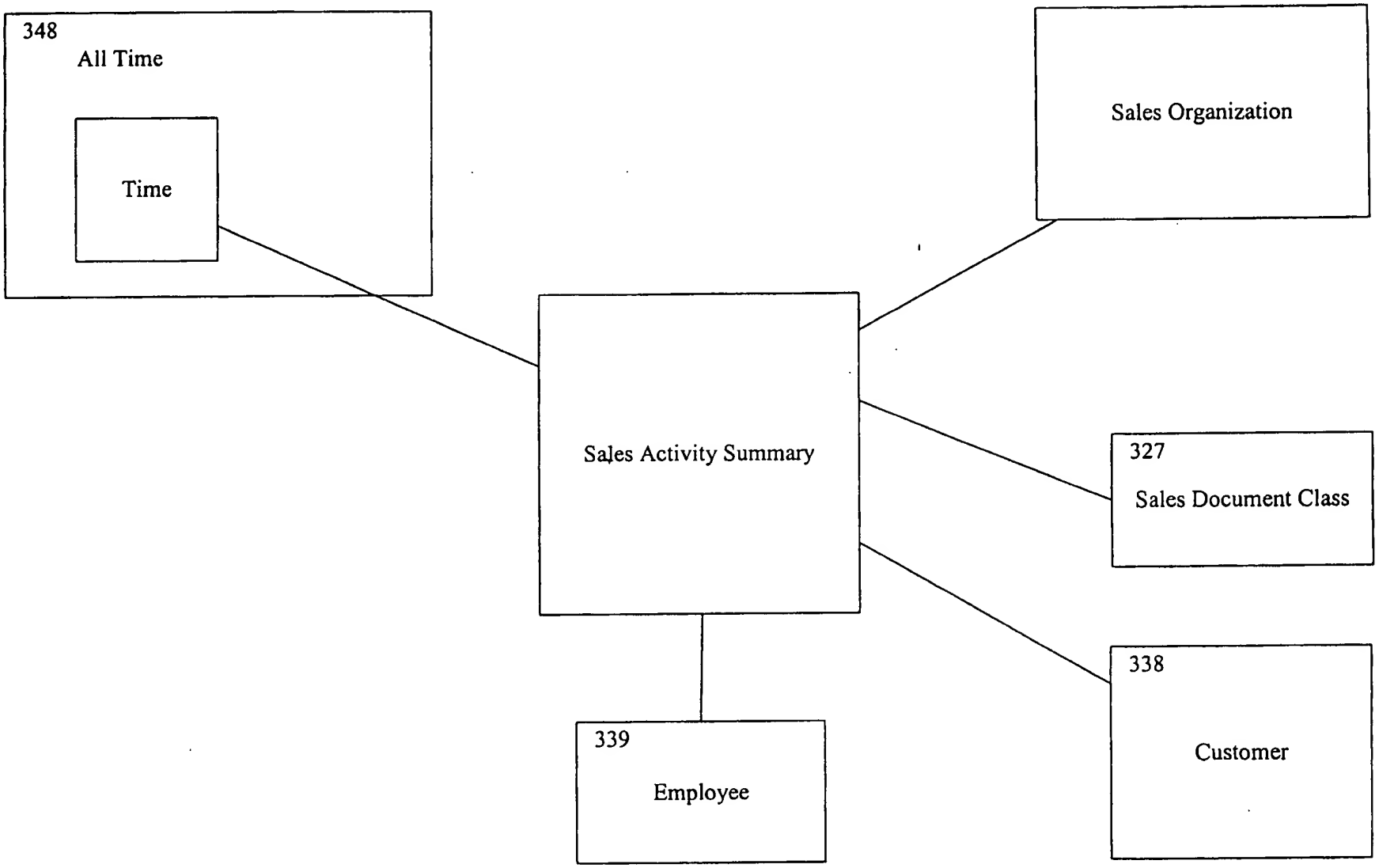


Figure 17P

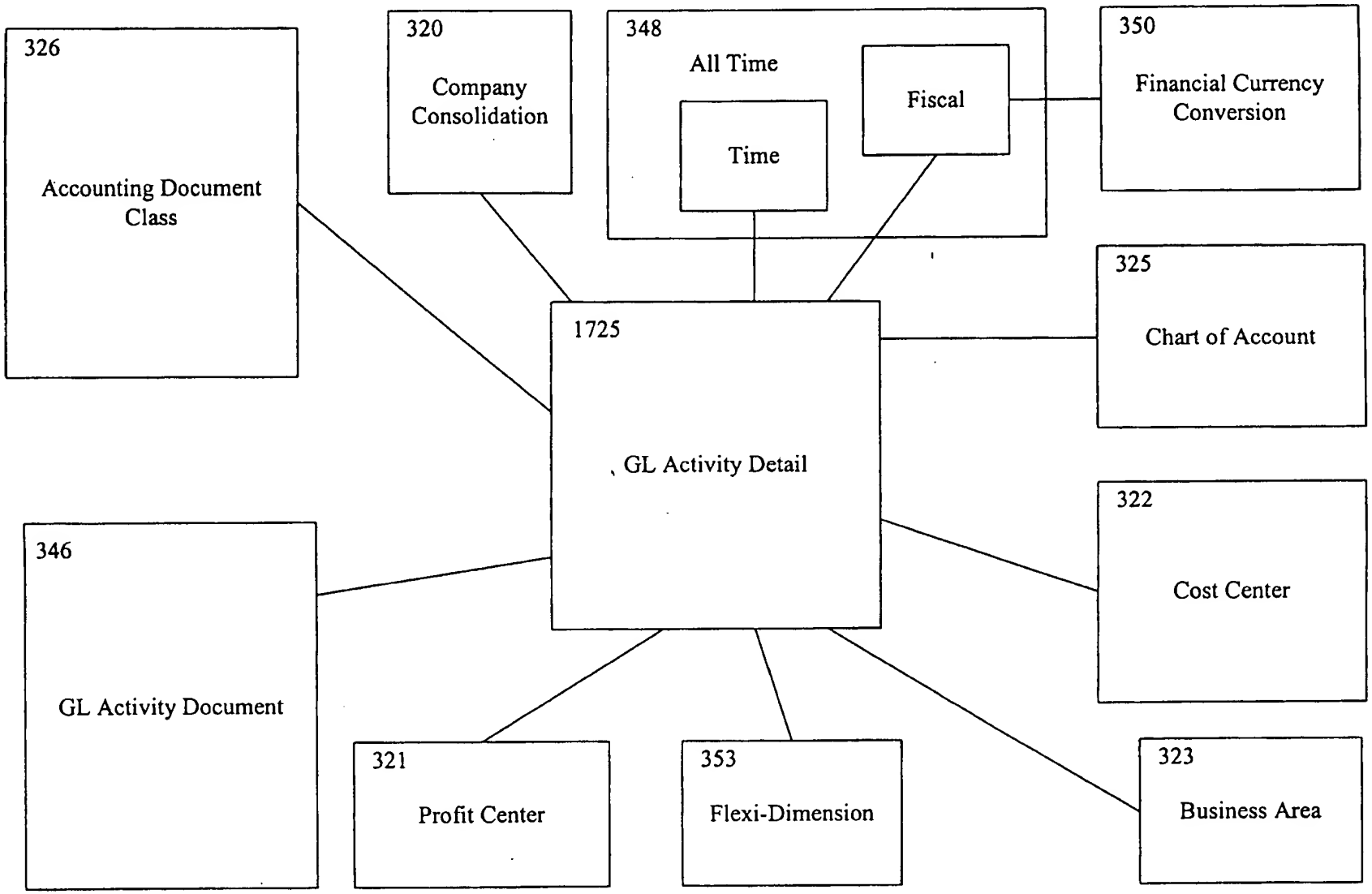


Figure 17Q

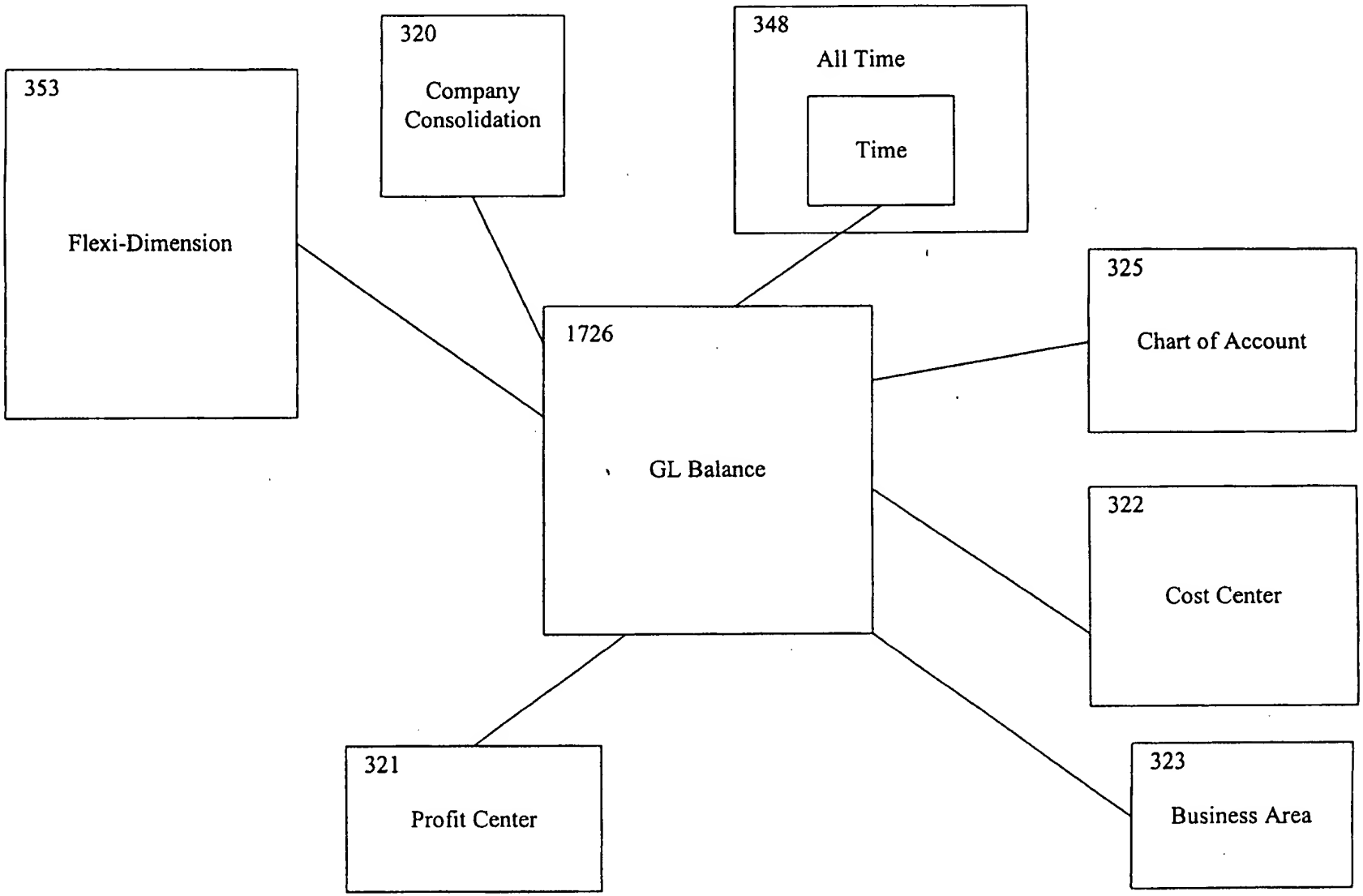


Figure 17R

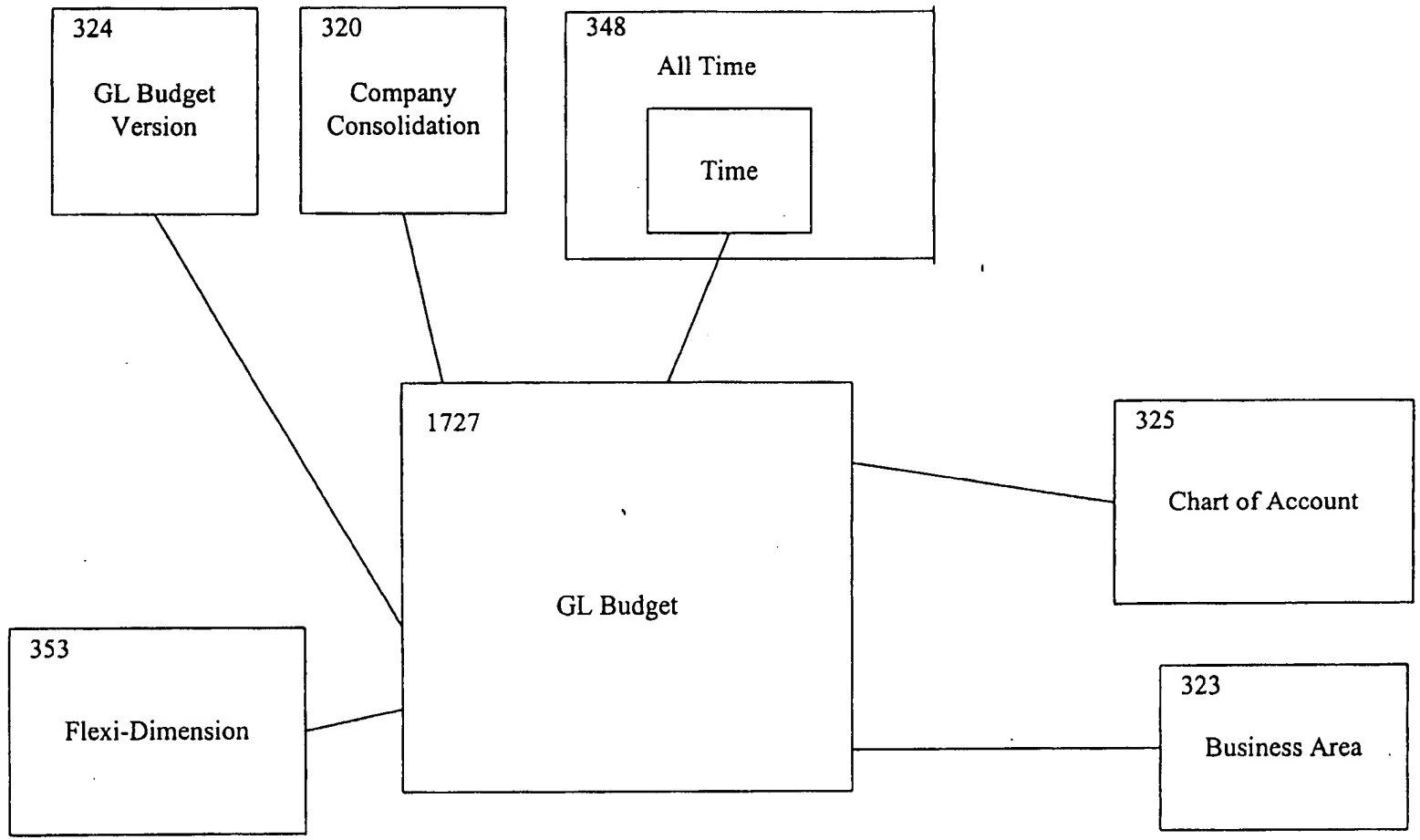


Figure 17S

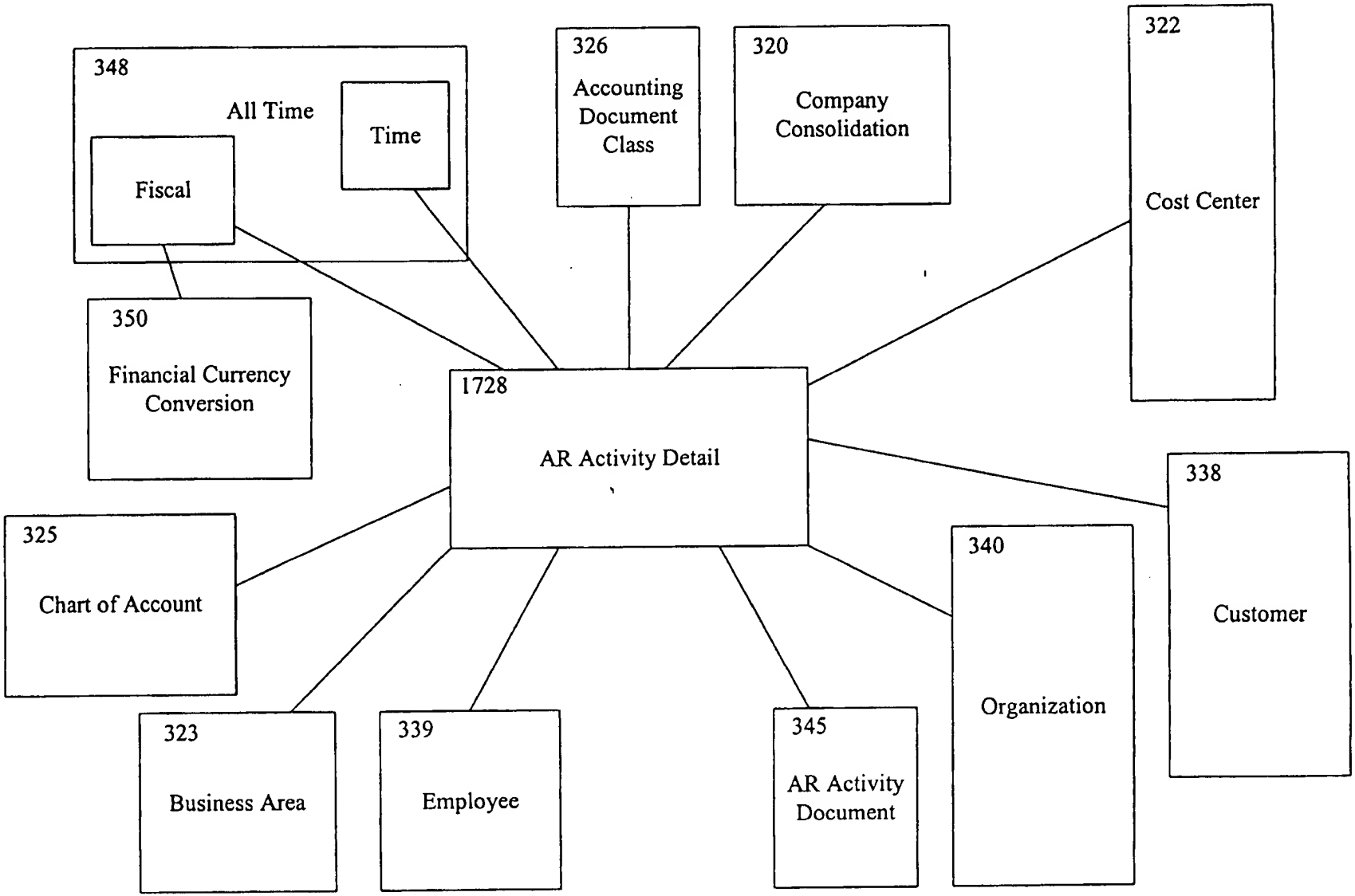


Figure 17T

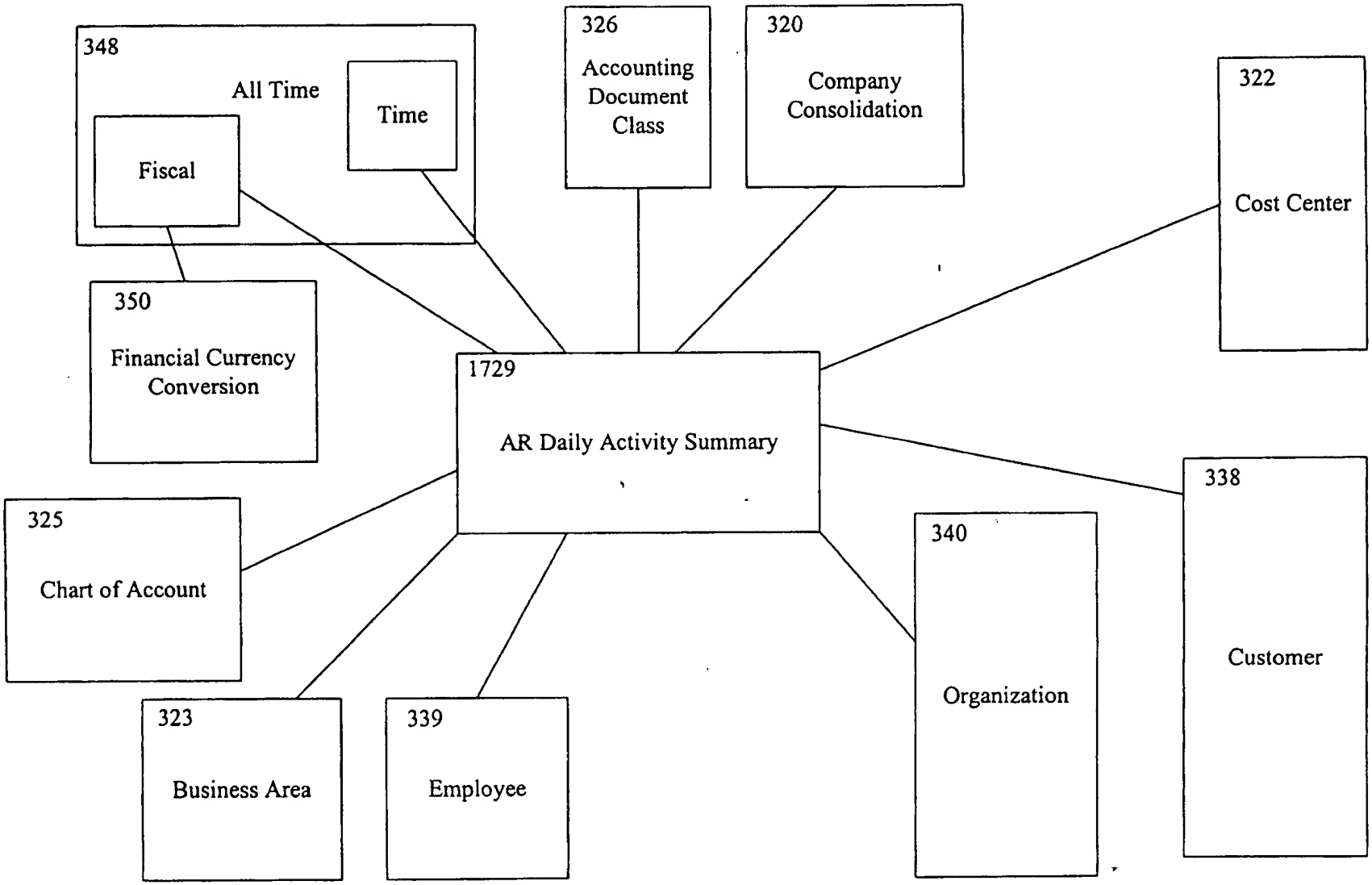


Figure 17U

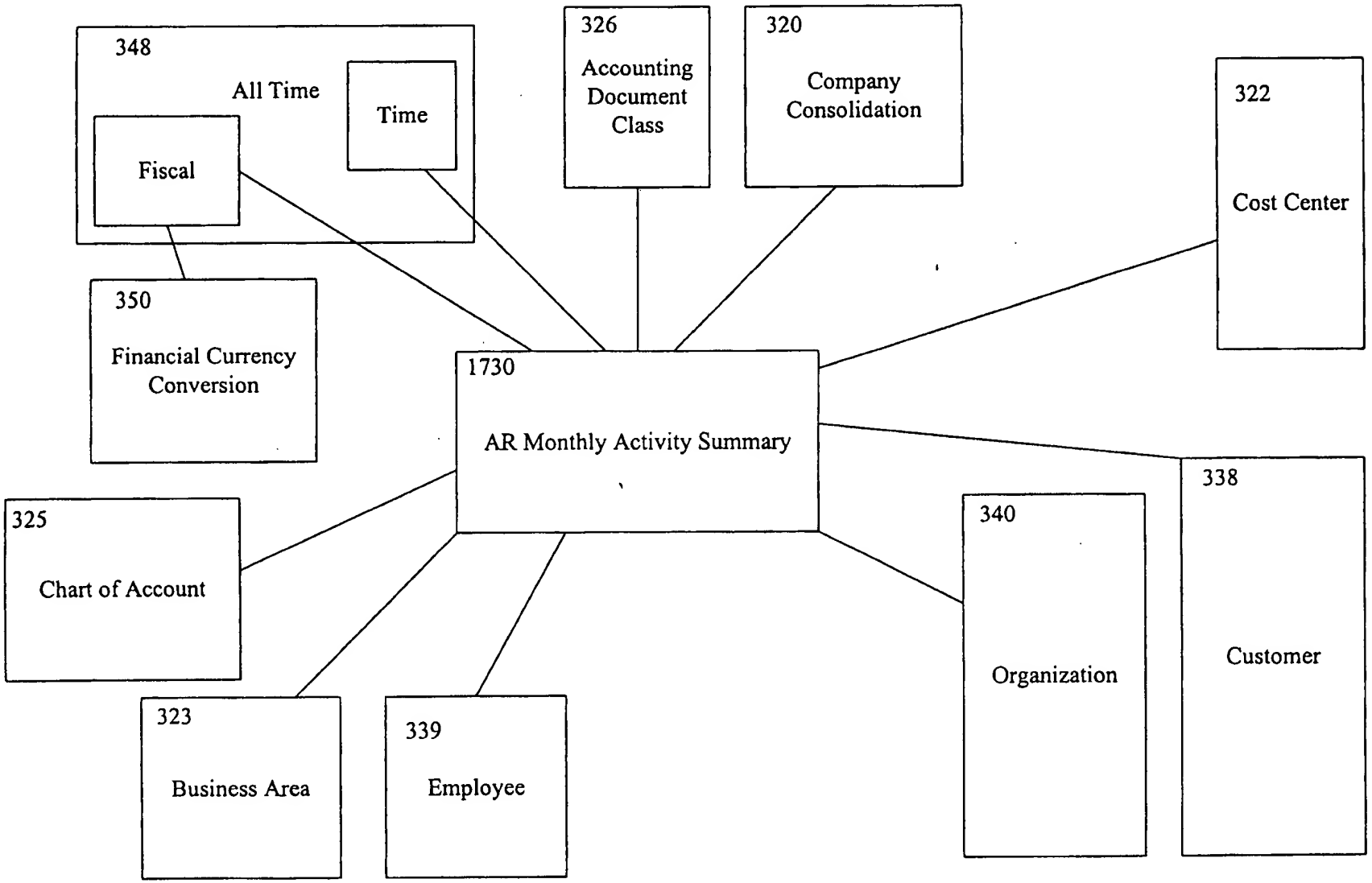

348
All Time
Time
Fiscal
326
Accounting Document Class
320
Company Consolidation
322
Cost Center
350
Financial Currency Conversion
1730
AR Monthly Activity Summary
325
Chart of Account
323
Business Area
339
Employee
340
Organization
338
Customer

Figure 17V

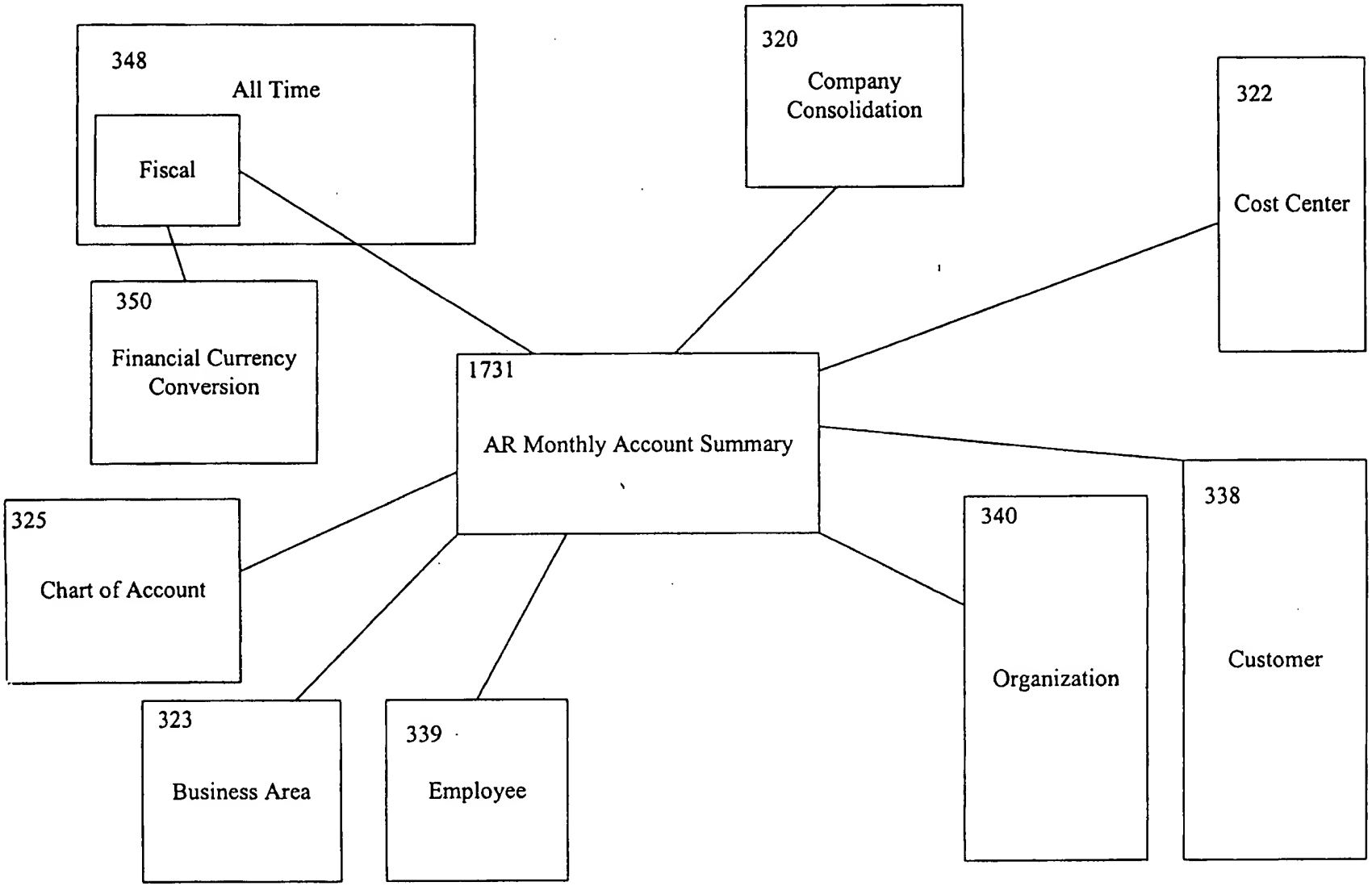


Figure 17W

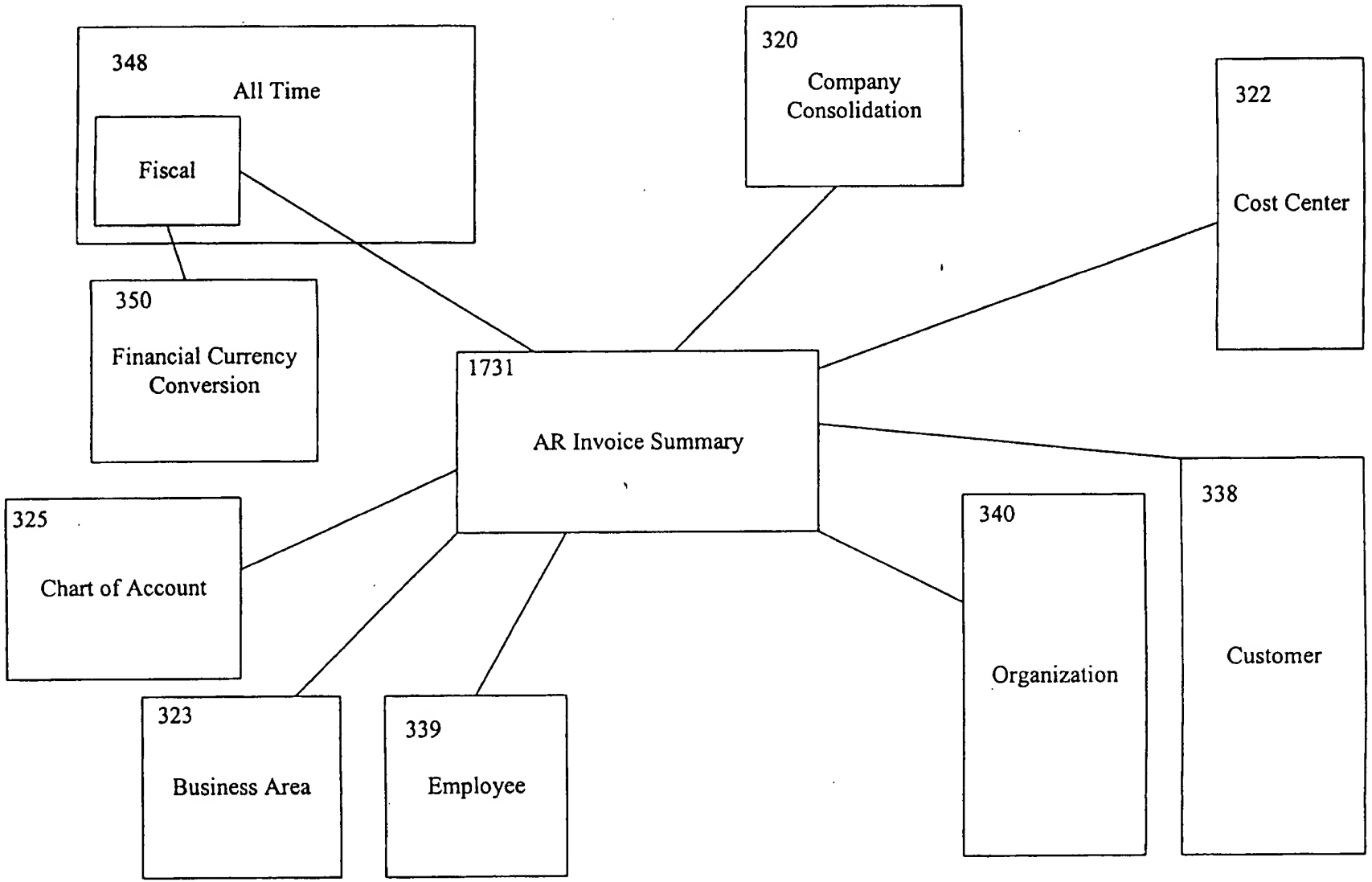


Figure 17X

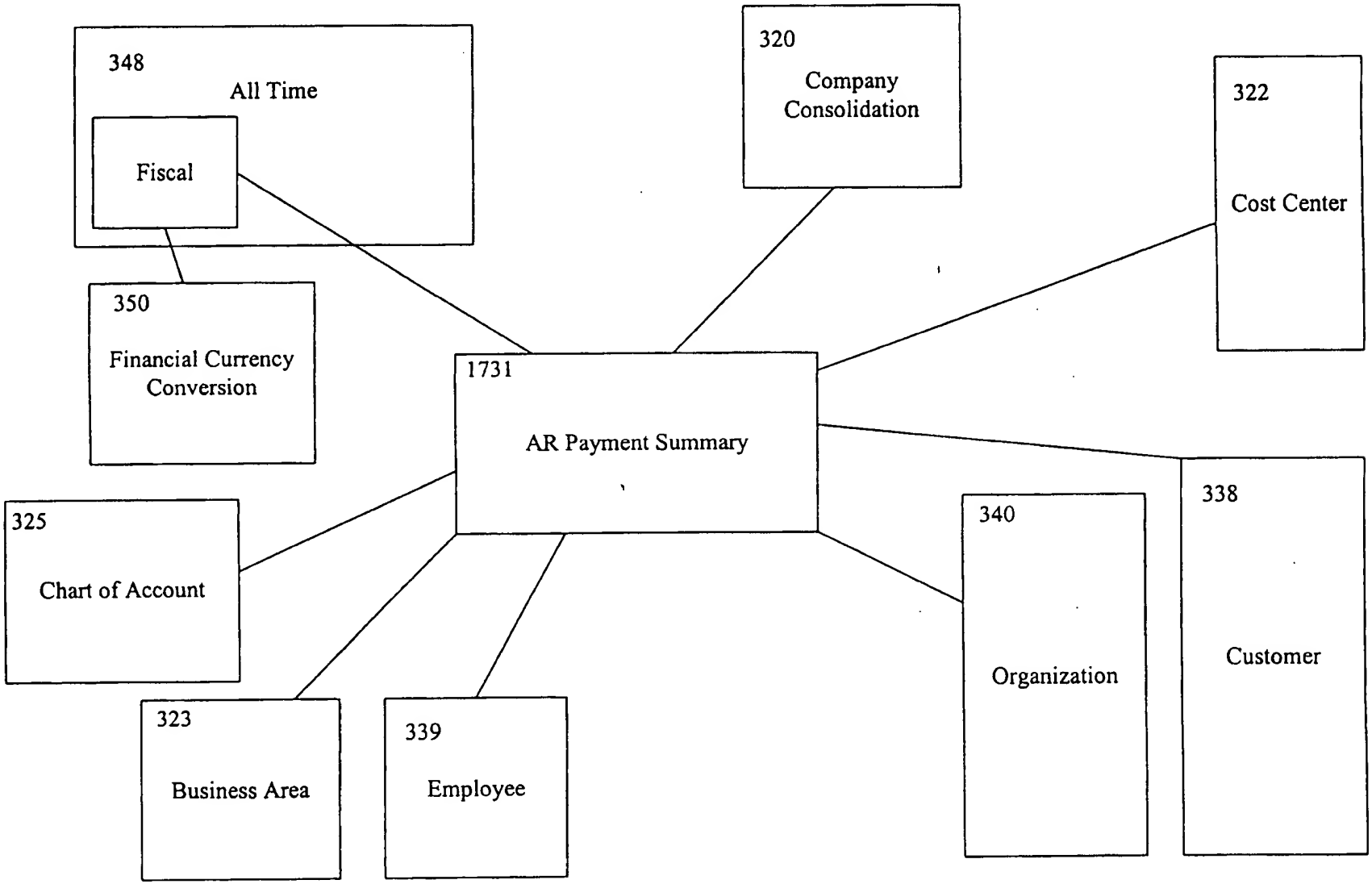


Figure 17Y

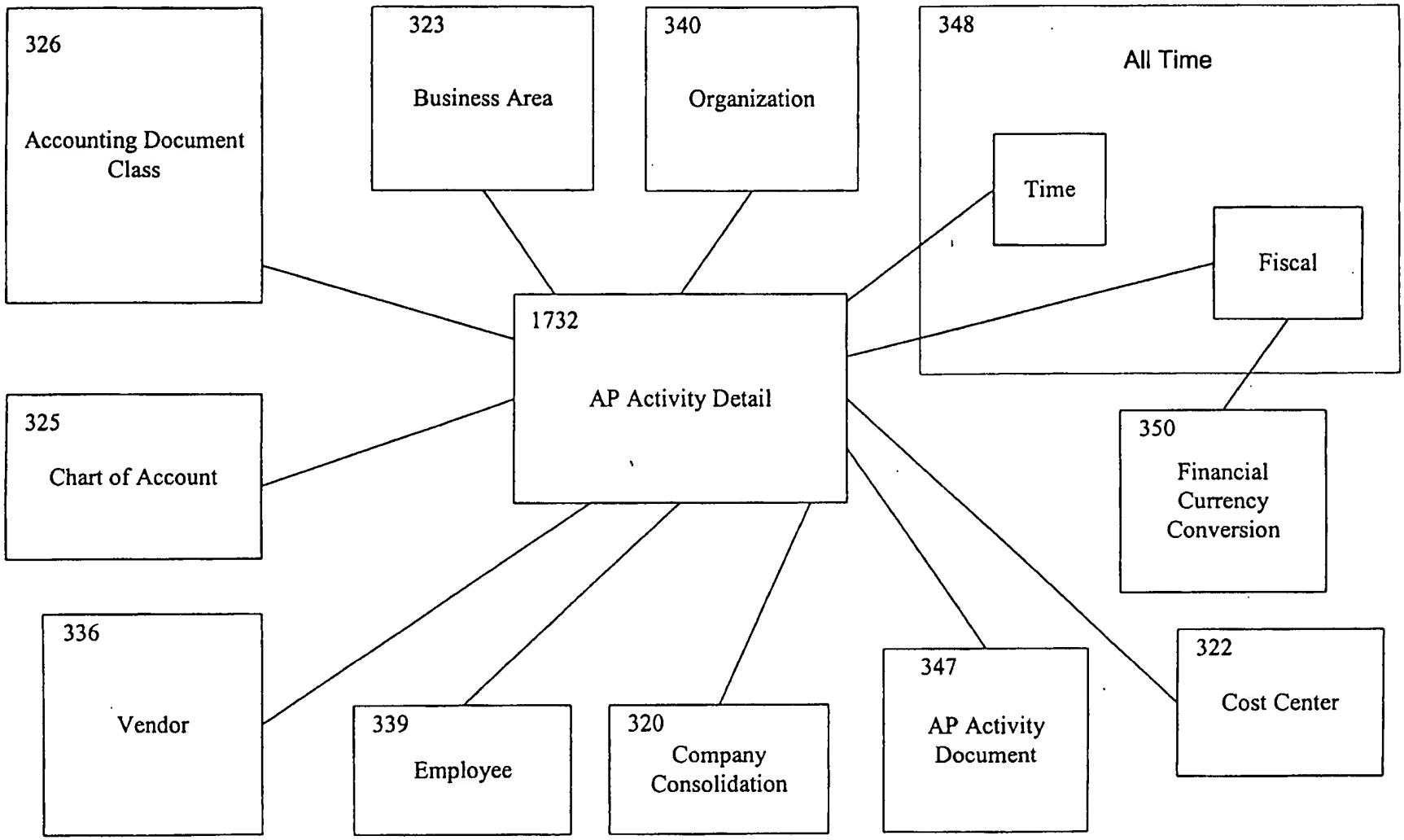


Figure 17Z

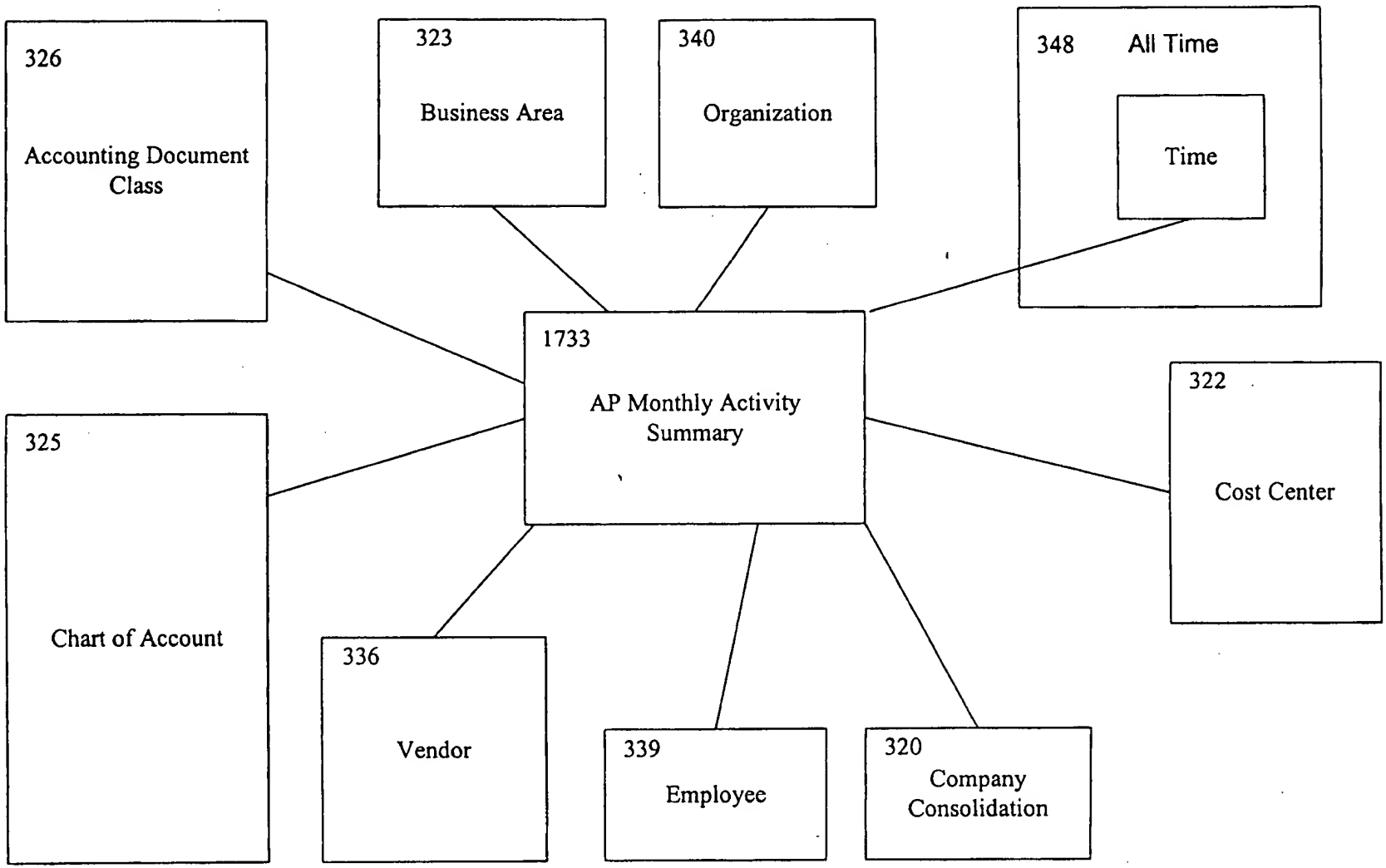


Figure 17AA

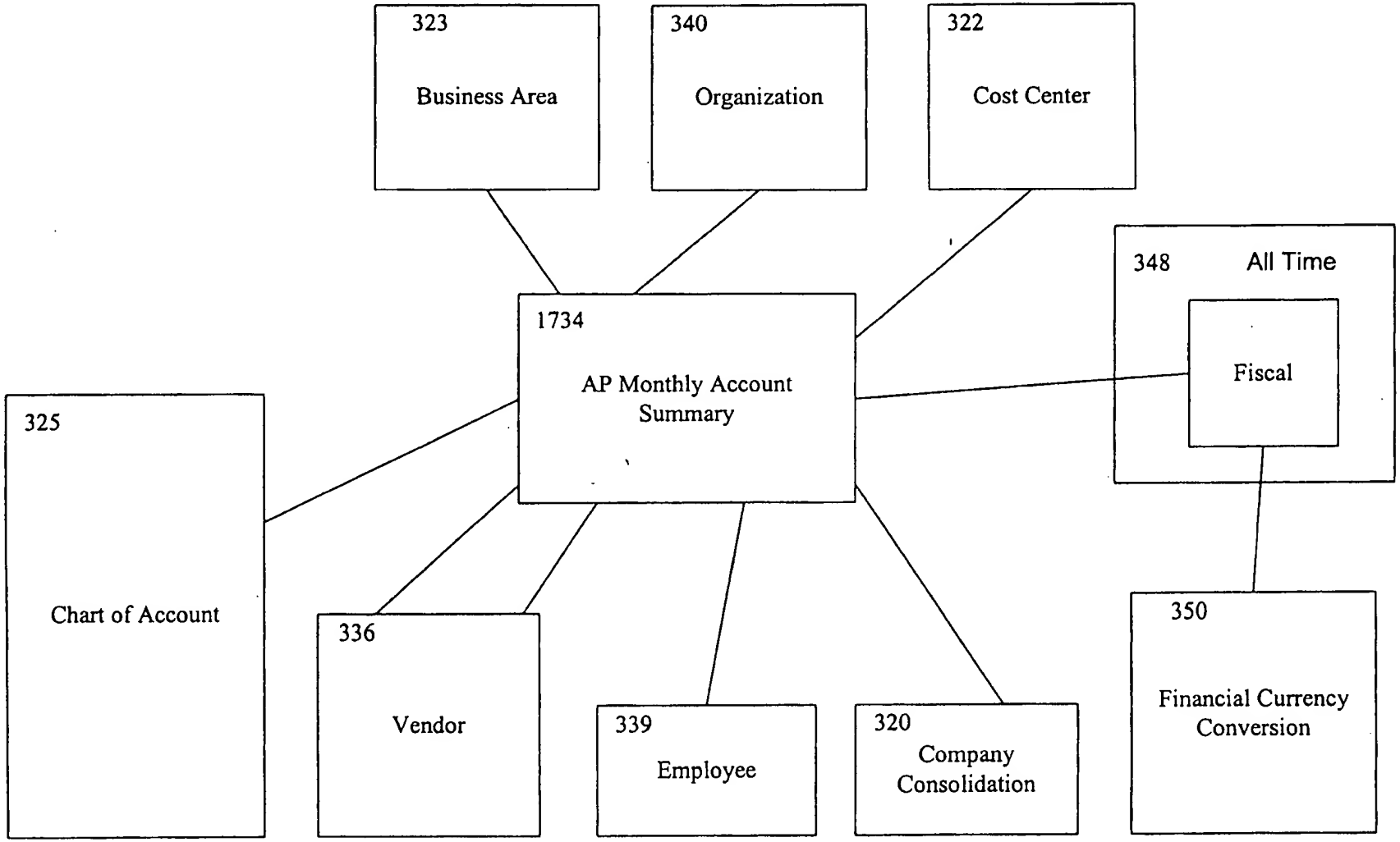


Figure 17AB

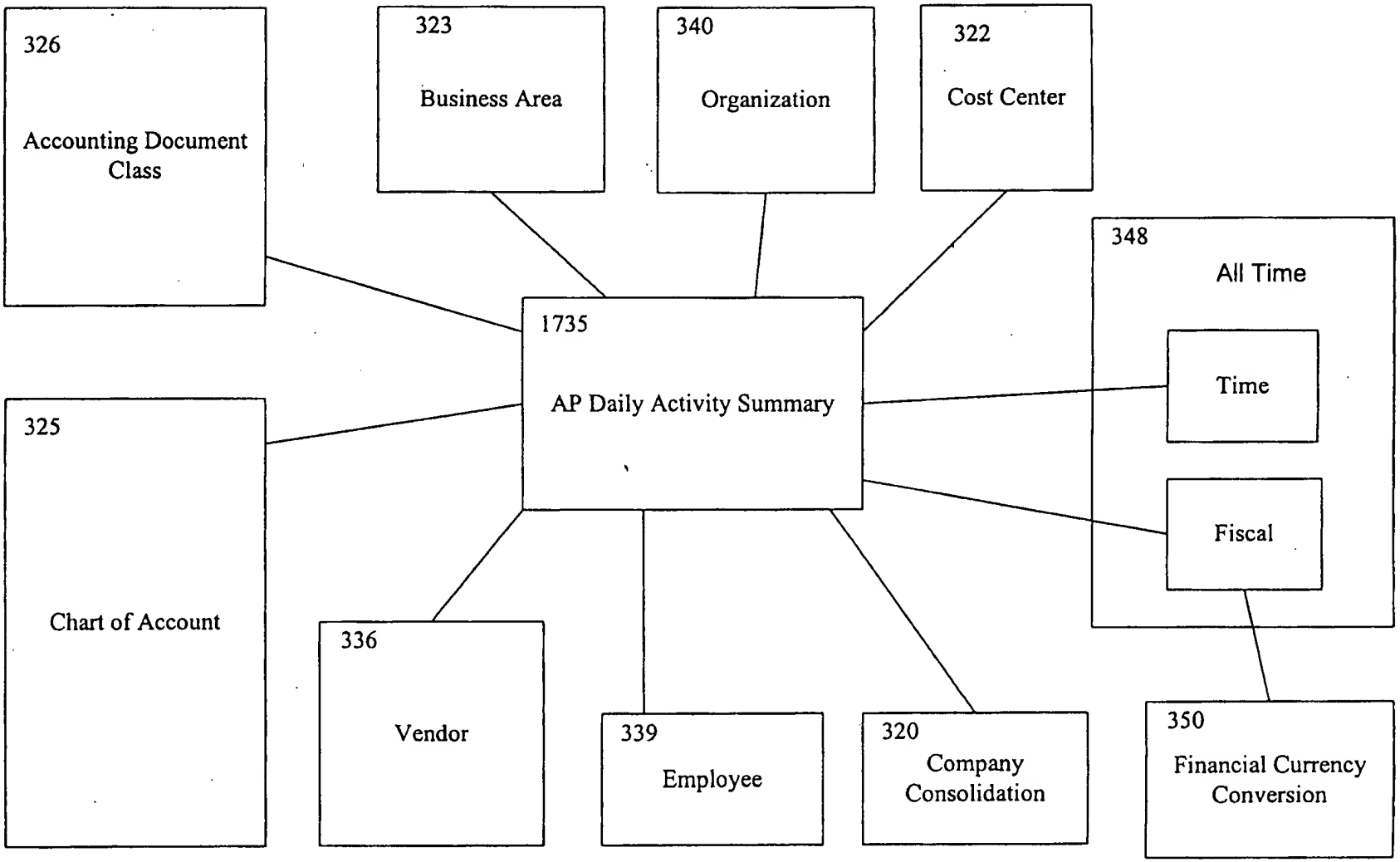


Figure 17AC

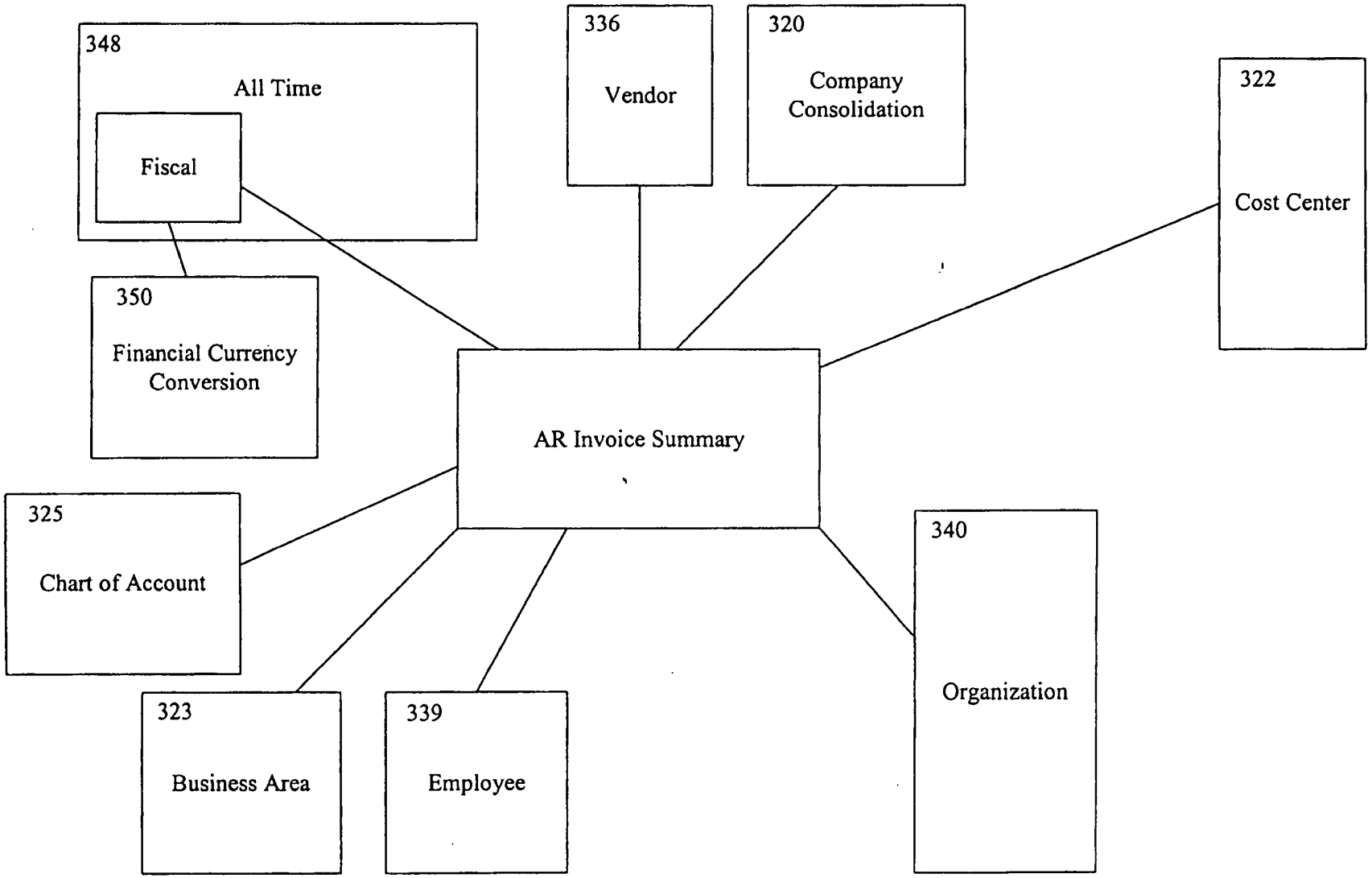


Figure 17AD

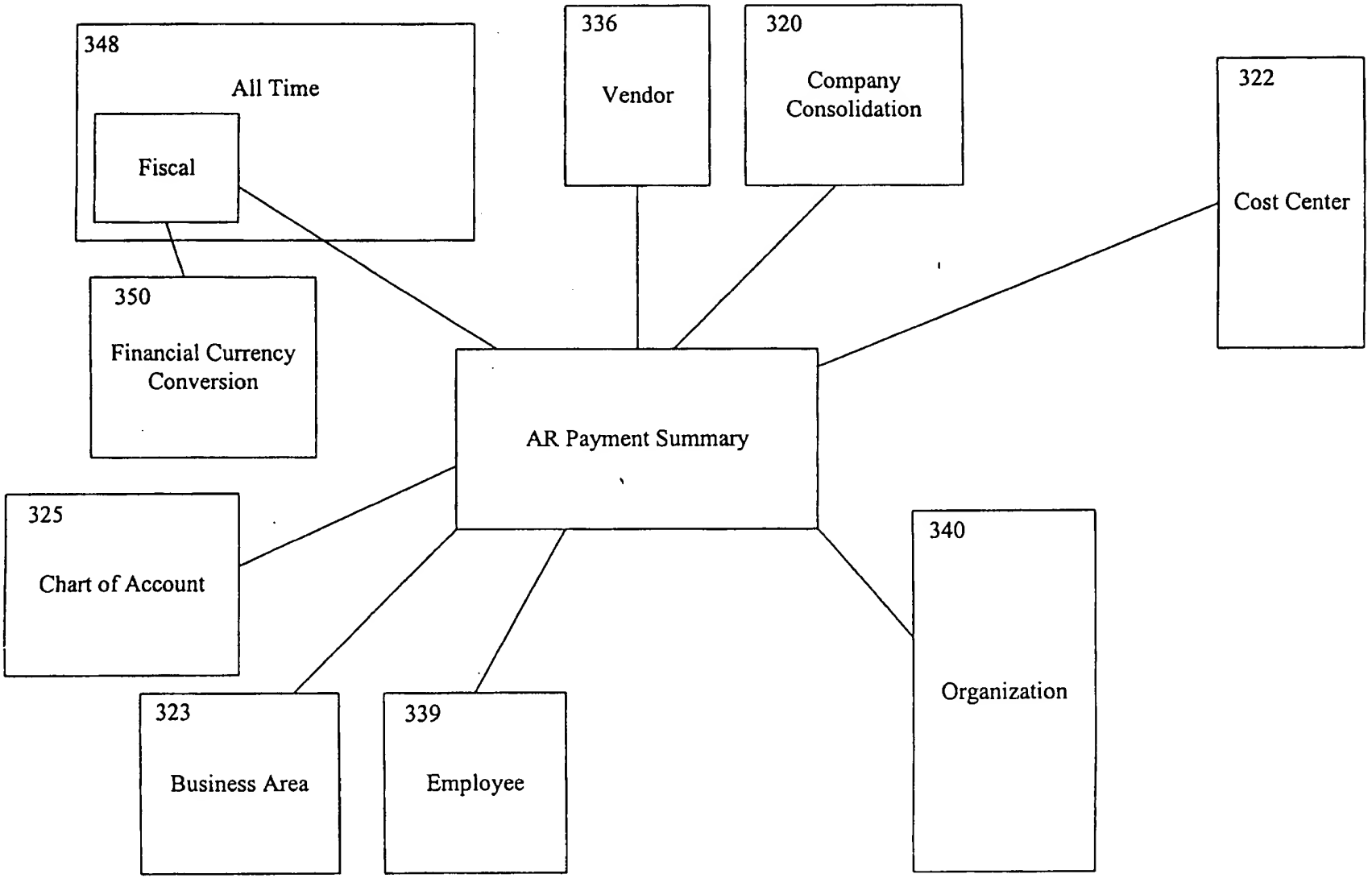


Figure 17AE

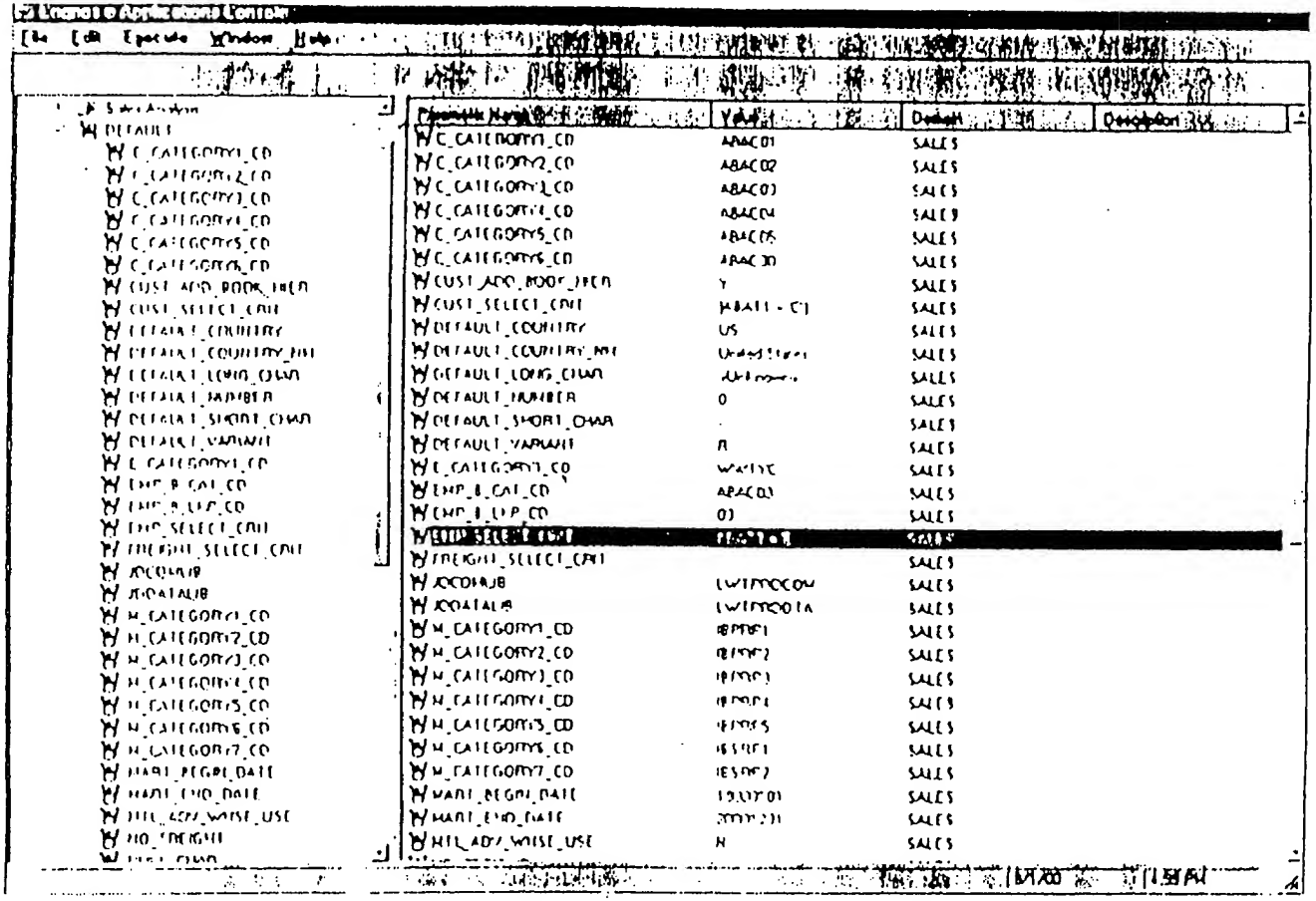


Figure 18

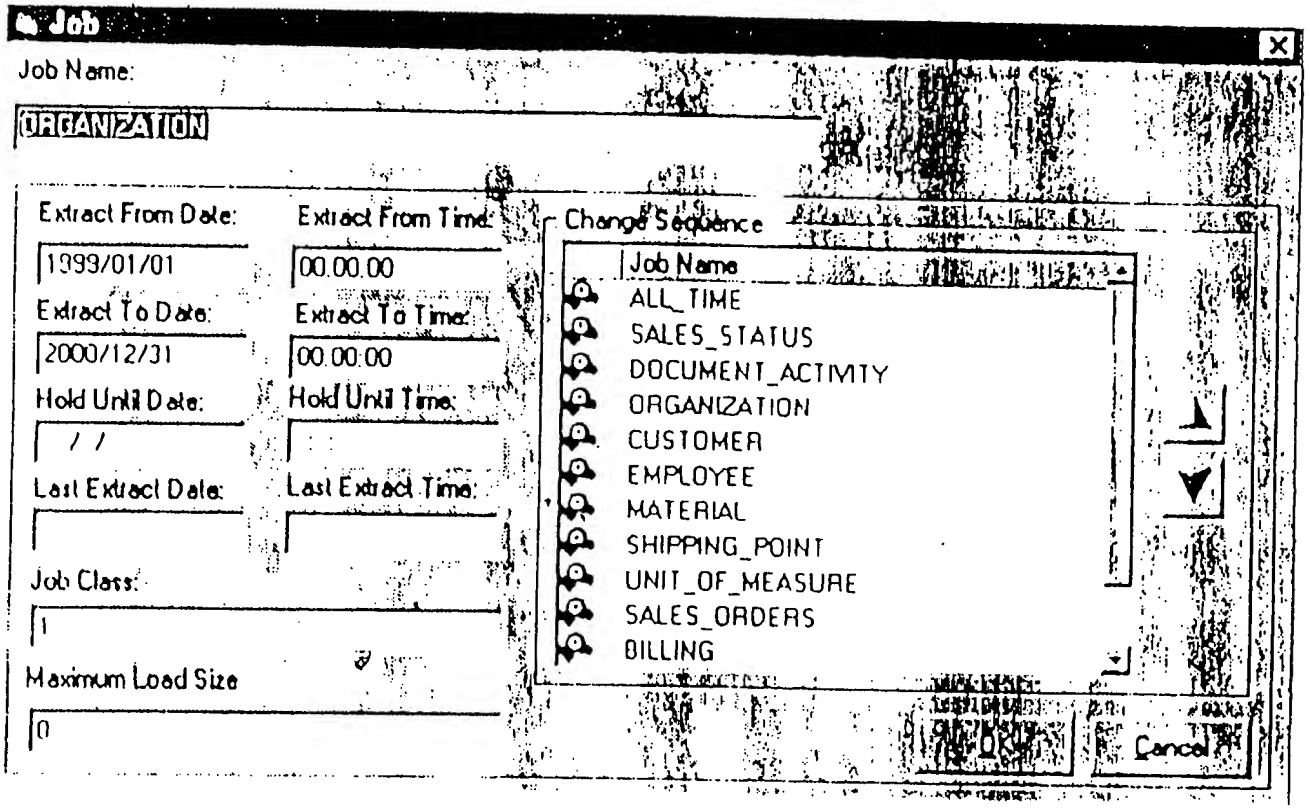
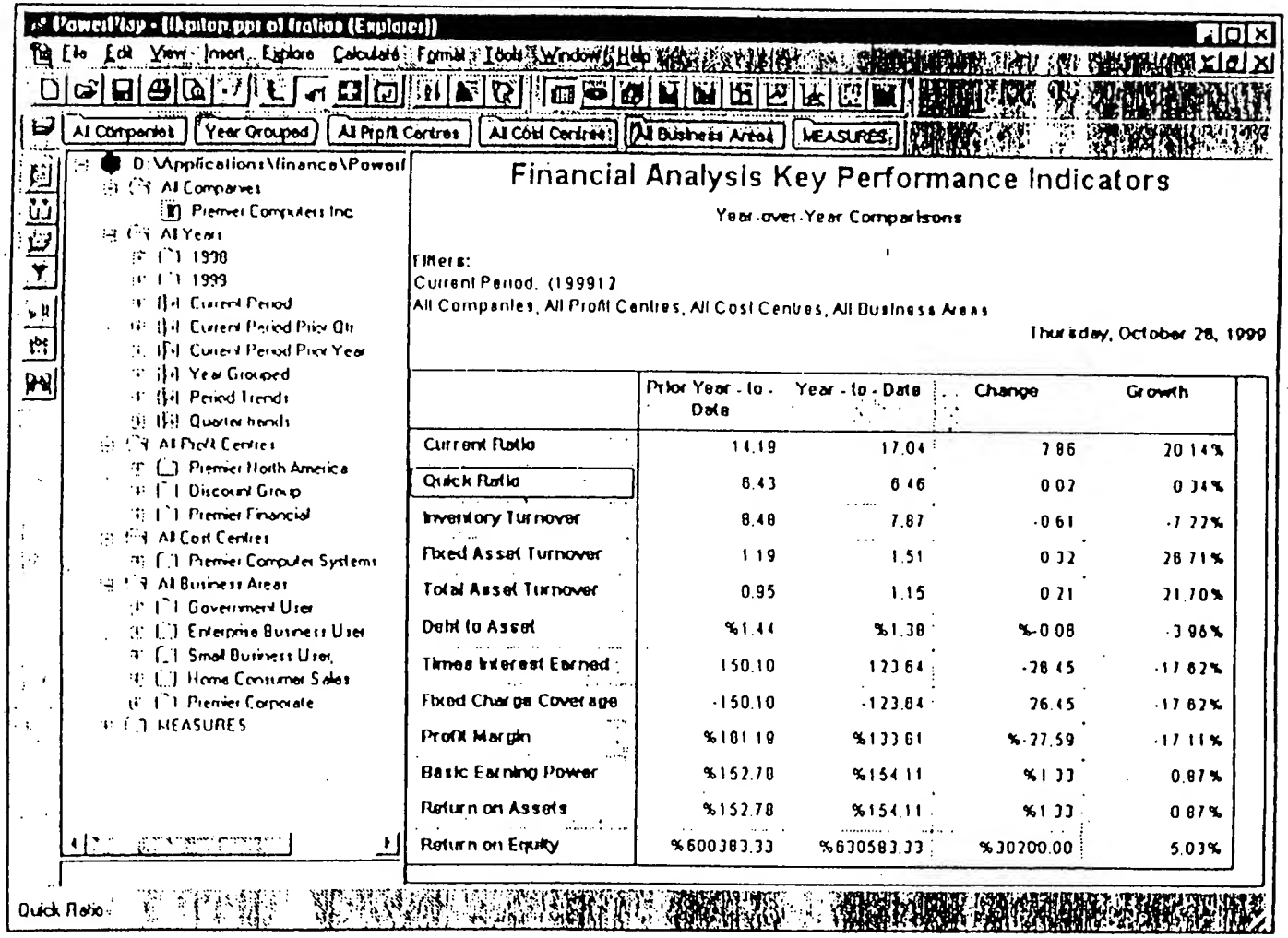


Figure 19



	Prior Year - to - Date	Year - to - Date	Change	Growth
Current Ratio	14.19	17.04	2.86	20.14%
Quick Ratio	6.43	6.46	0.02	0.34%
Inventory Turnover	8.48	7.87	-0.61	-7.22%
Fixed Asset Turnover	1.19	1.51	0.32	26.71%
Total Asset Turnover	0.95	1.15	0.21	21.70%
Debt to Asset	%1.44	%1.38	%-0.06	-3.96%
Times Interest Earned	150.10	123.64	-26.45	-17.62%
Fixed Charge Coverage	-150.10	-123.64	26.45	-17.62%
Profit Margin	%101.10	%133.61	%-27.59	-17.11%
Basic Earning Power	%152.78	%154.11	%1.33	0.87%
Return on Assets	%152.78	%154.11	%1.33	0.87%
Return on Equity	%600383.33	%630583.33	%30200.00	5.03%

Figure 20

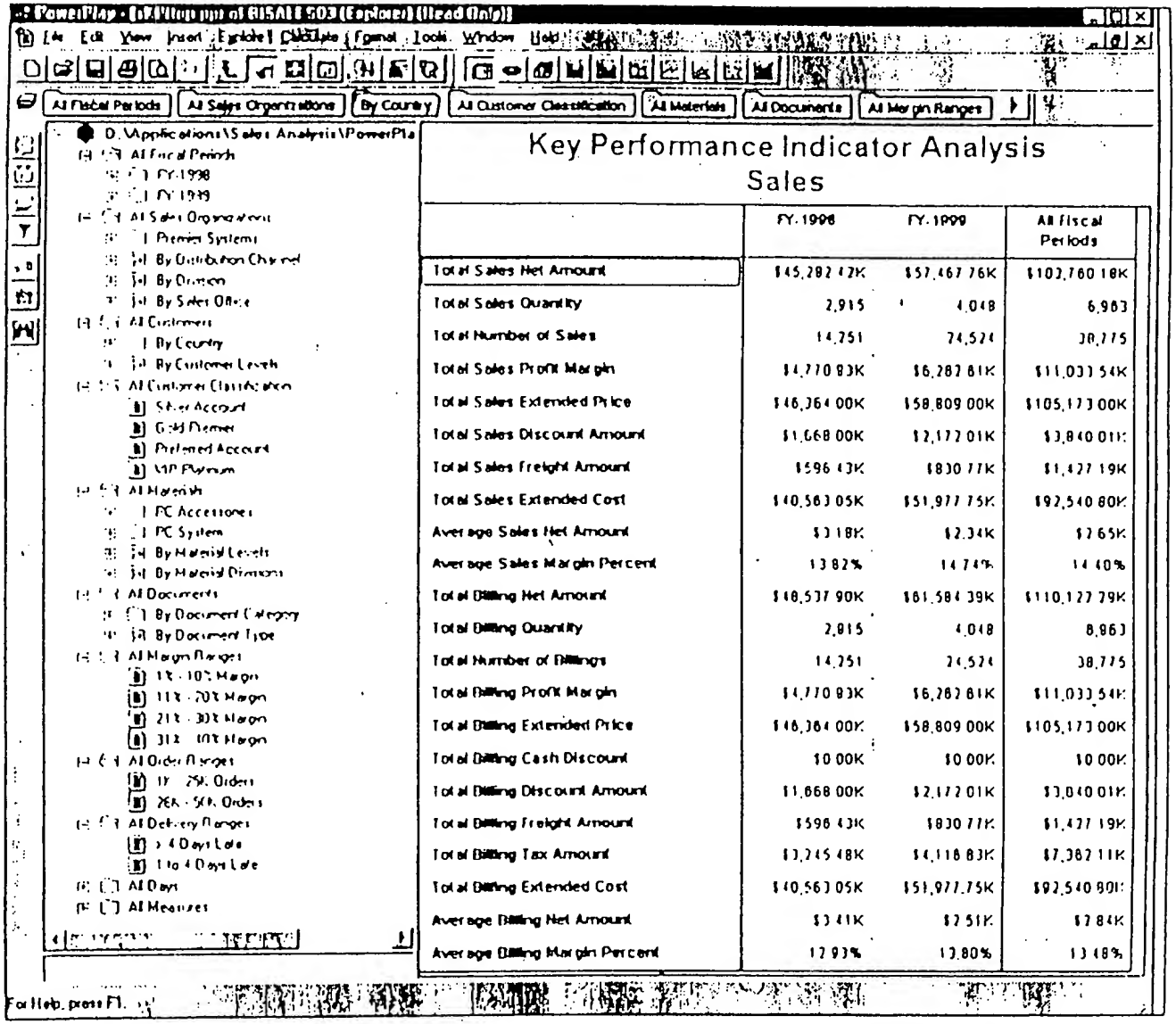


Figure 21

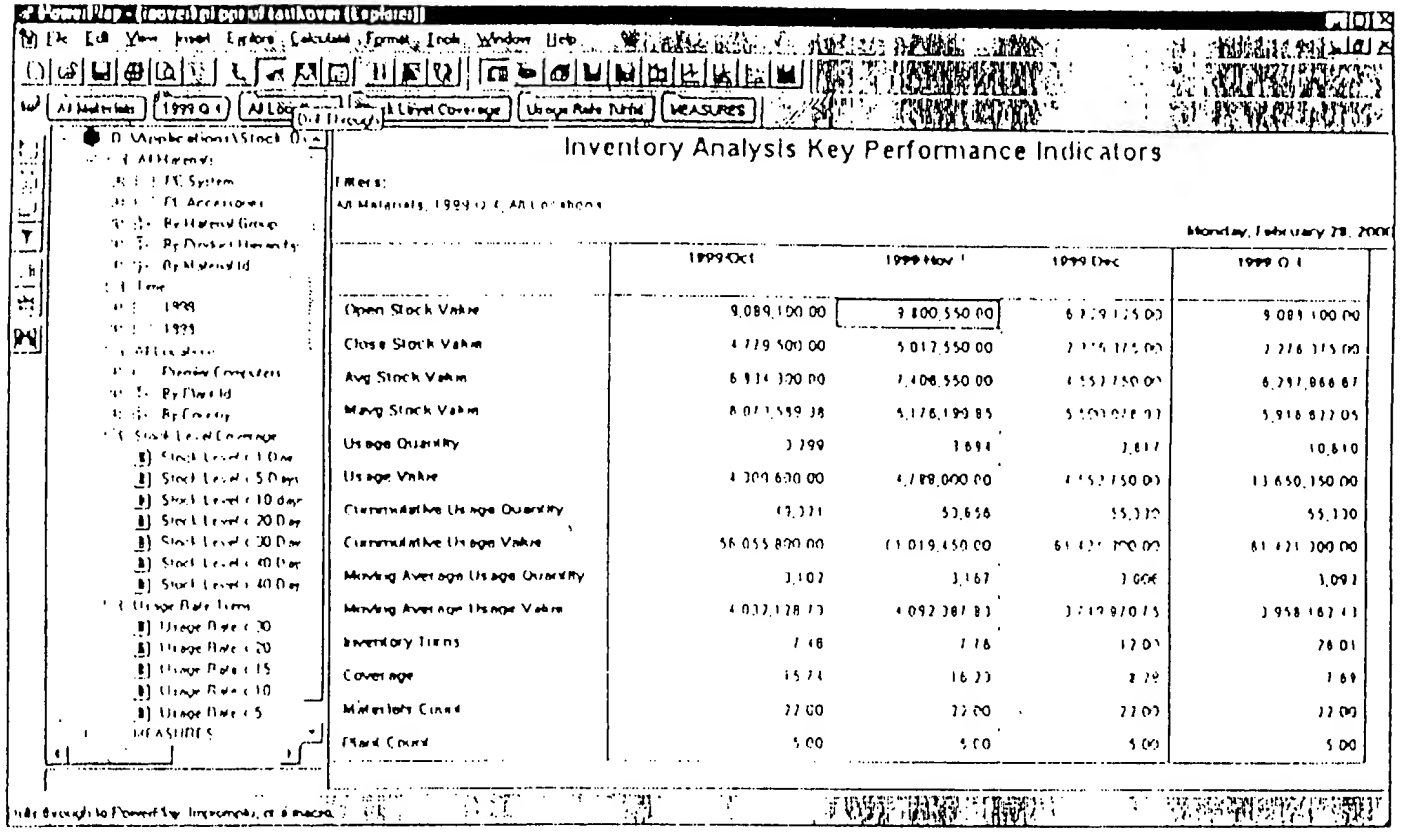

Inventory Analysis Key Performance Indicators
Filters:
Monday, February 28, 2000
1999 Oct
1999 Nov
1999 Dec
1999 Q 4
Open Stock Value
9,089,100.00
9,800,550.00
Close Stock Value
4,739,500.00
5,017,550.00
Avg Stock Value
6,914,300.00
7,408,550.00
Mavg Stock Value
8,073,599.38
5,176,199.85
Usage Quantity
3,799
3,694
10,810
Usage Value
4,309,630.00
4,189,000.00
13,650,150.00
Cumulative Usage Quantity
53,656
55,330
Cumulative Usage Value
56,055,890.00
61,421,300.00
Moving Average Usage Quantity
3,102
3,167
3,093
Moving Average Usage Value
4,032,128.73
4,092,387.83
3,958,182.43
Inventory Items
7,146
7,176
7,201
7,801
Coverage
15.74
16.23
7.69
Material Count
22.00
22.00
22.00
22.00
Plant Count
5.00
5.00
5.00
5.00

Figure 22

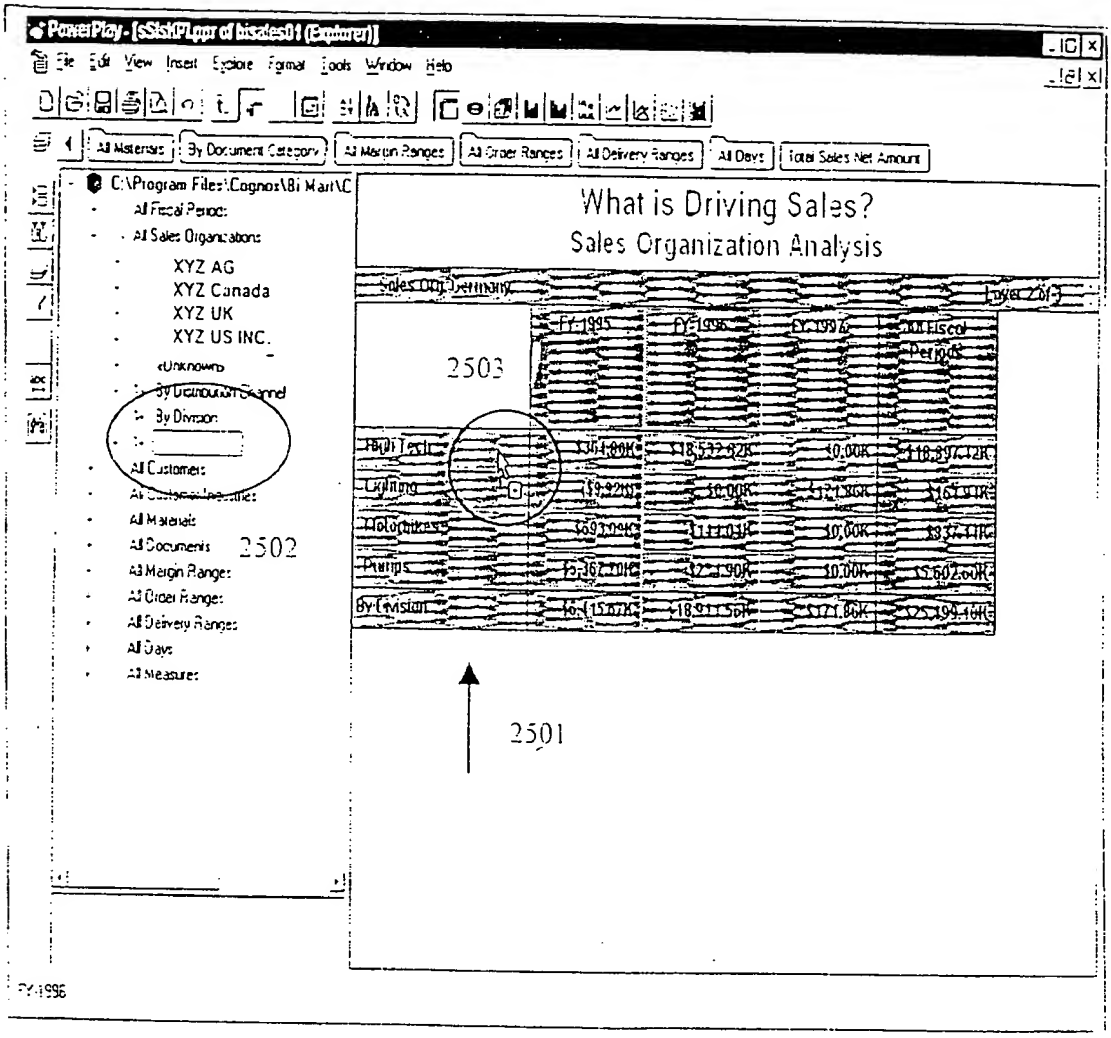

What is Driving Sales?
Sales Organization Analysis
2503
2502
2501
XYZ AG
XYZ Canada
XYZ UK
XYZ US INC.
All Fiscal Periods
All Sales Organizations
All Customers
All Materials
All Documents
All Margin Ranges
All Order Ranges
All Delivery Ranges
All Days
All Measures
By Division
All Materials
By Document Category
All Margin Ranges
All Order Ranges
All Delivery Ranges
All Days
Total Sales Net Amount

Figure 23

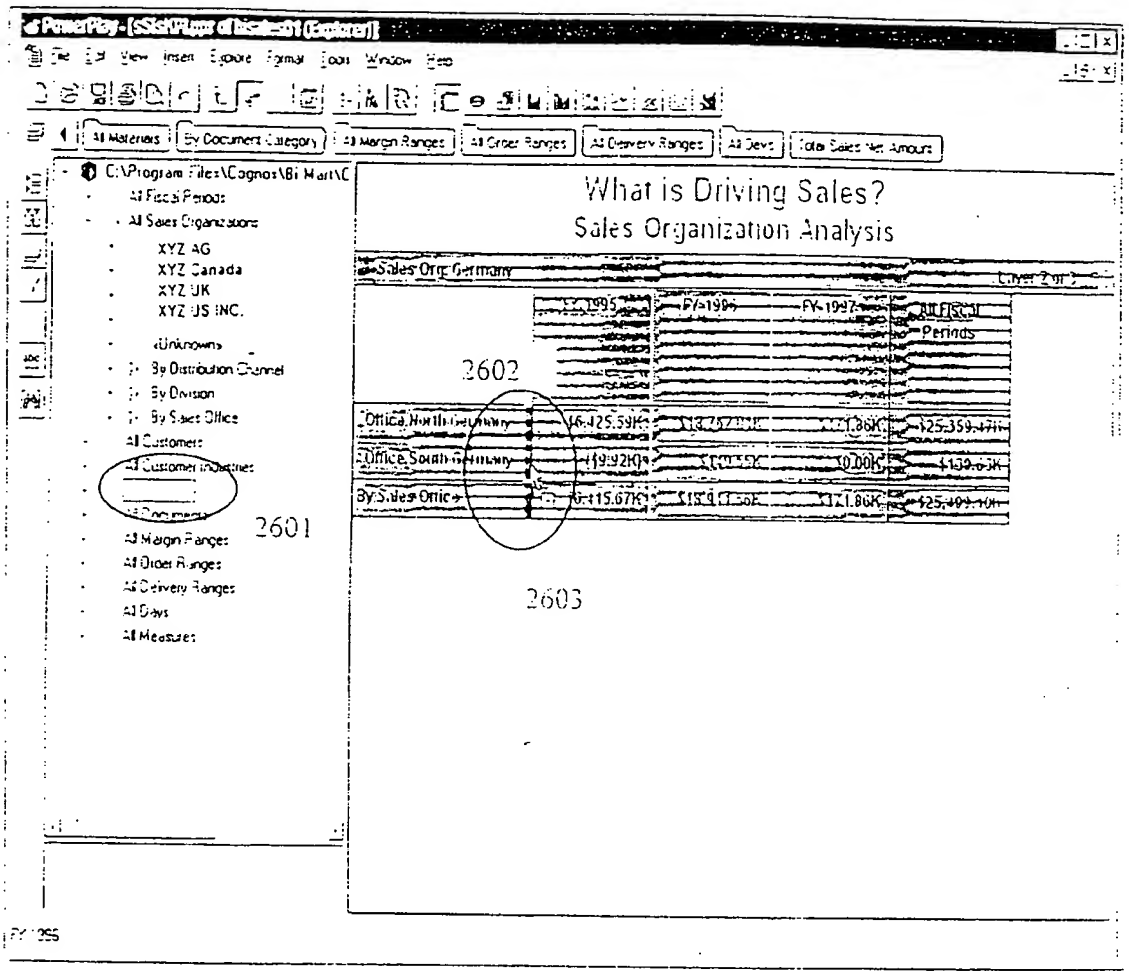

All Materials
By Document Category
All Margin Ranges
All Order Ranges
All Delivery Ranges
All Days
Total Sales Net Amount
C:\Program Files\Cognos\Bi Mart\C
All Fiscal Periods
All Sales Organizations
XYZ AG
XYZ Canada
XYZ UK
XYZ US INC.
<Unknown>
By Distribution Channel
By Division
By Sales Office
All Customers
All Customer Industries
All Margin Ranges
All Order Ranges
All Delivery Ranges
All Days
All Measures
2601
What is Driving Sales?
Sales Organization Analysis
Sales Org Germany
FY 1995
FY 1996
FY 1997
All Fiscal Periods
2602
Office North Germany
Office South Germany
By Sales Office
2603

Figure 24

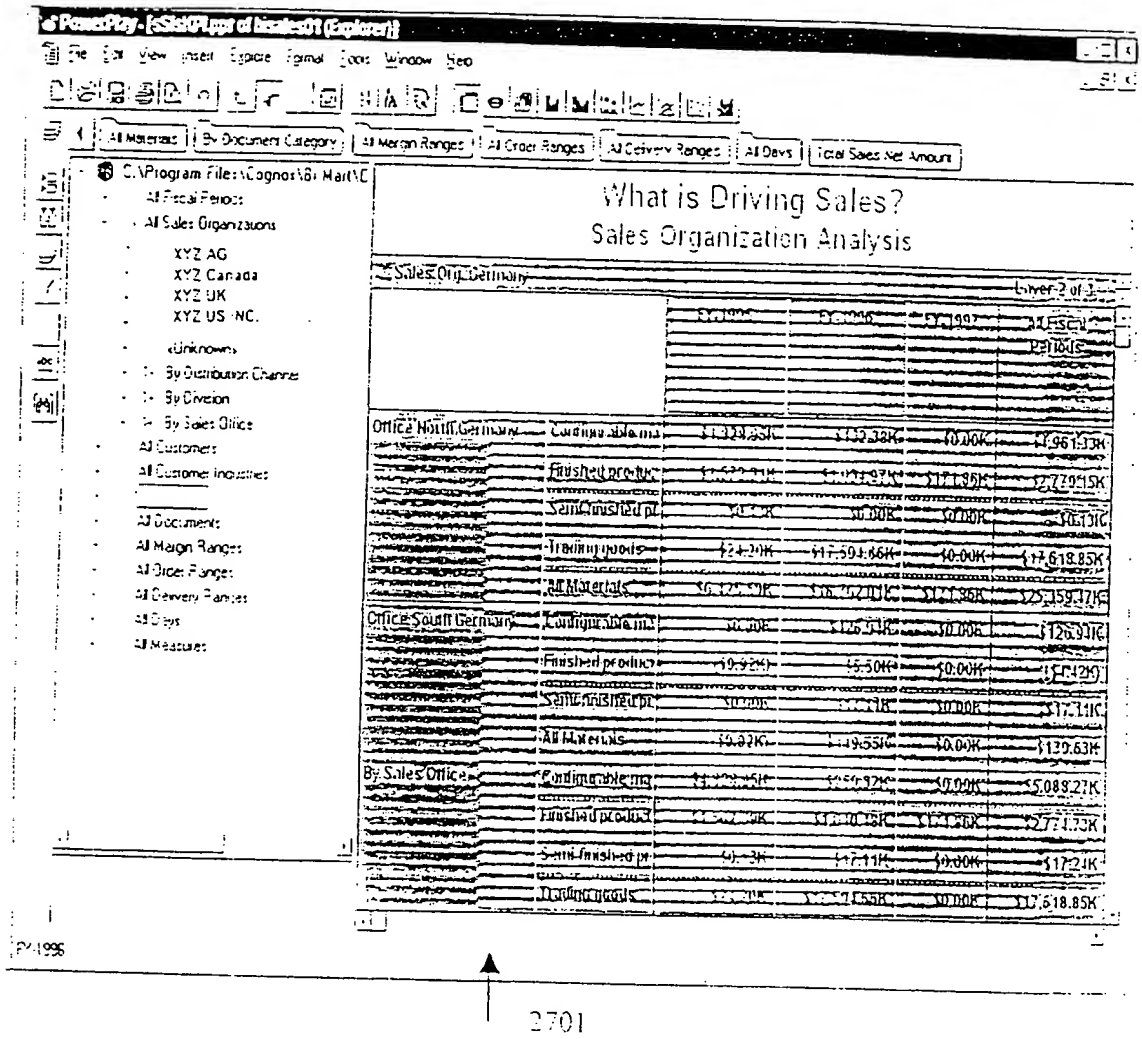

What is Driving Sales?
Sales Organization Analysis
All Materials
By Document Category
All Margin Ranges
All Order Ranges
All Delivery Ranges
All Days
Total Sales Net Amount
All Fiscal Periods
All Sales Organizations
XYZ AG
XYZ Canada
XYZ UK
XYZ US INC.
<Unknown>
By Distribution Channel
By Division
By Sales Office
All Customers
All Customer Industries
All Document
All Margin Ranges
All Order Ranges
All Delivery Ranges
All Days
All Measures
Sales Org: German
Office: North German
Office: South German
By Sales Office
Finished products
Trading goods
All Materials
FY 1996
2701

Figure 25

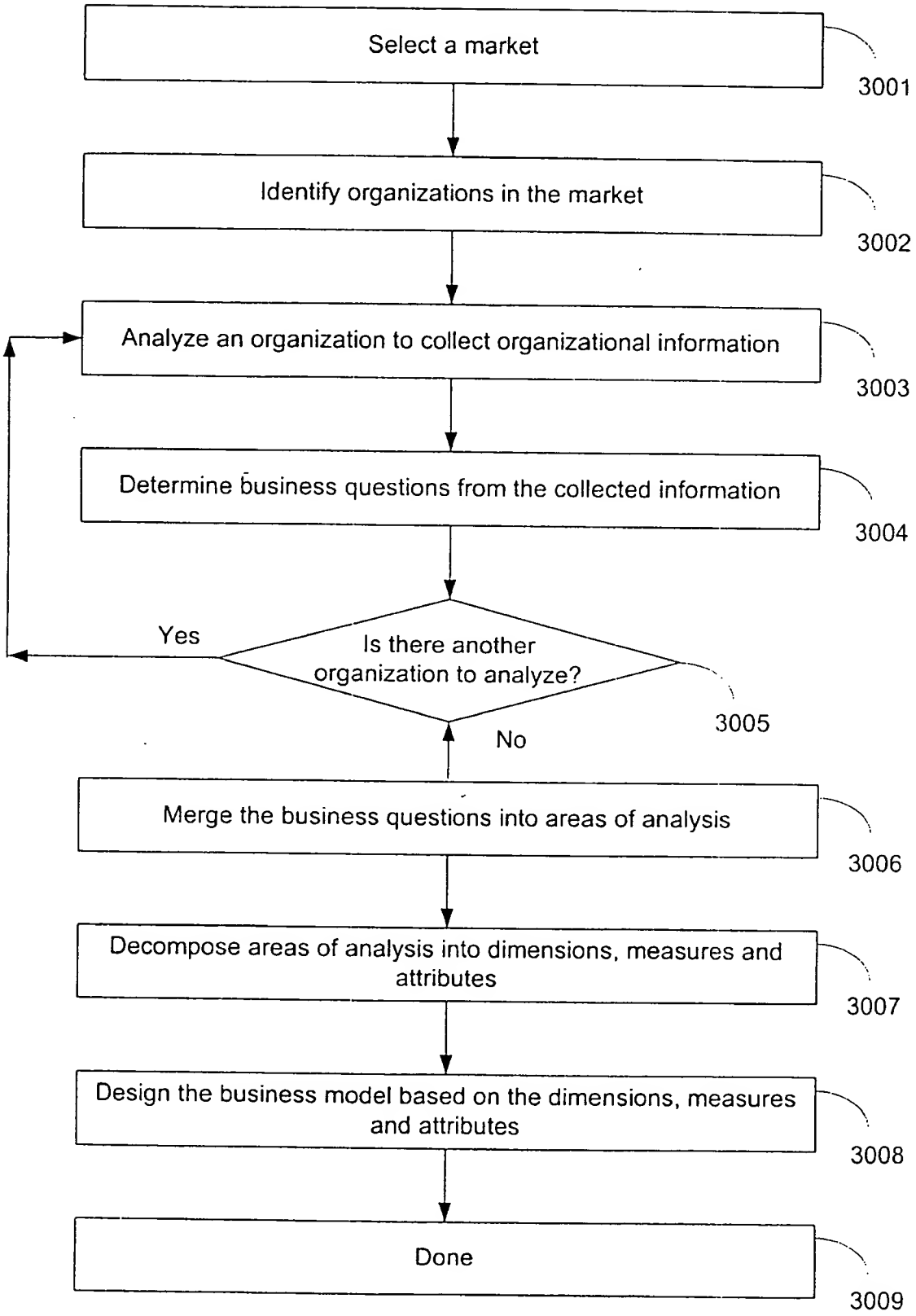

Select a market
3001
Identify organizations in the market
3002
Analyze an organization to collect organizational information
3003
Determine business questions from the collected information
3004
Is there another organization to analyze?
3005
Yes
No
Merge the business questions into areas of analysis
3006
Decompose areas of analysis into dimensions, measures and attributes
3007
Design the business model based on the dimensions, measures and attributes
3008
Done
3009

Figure 26

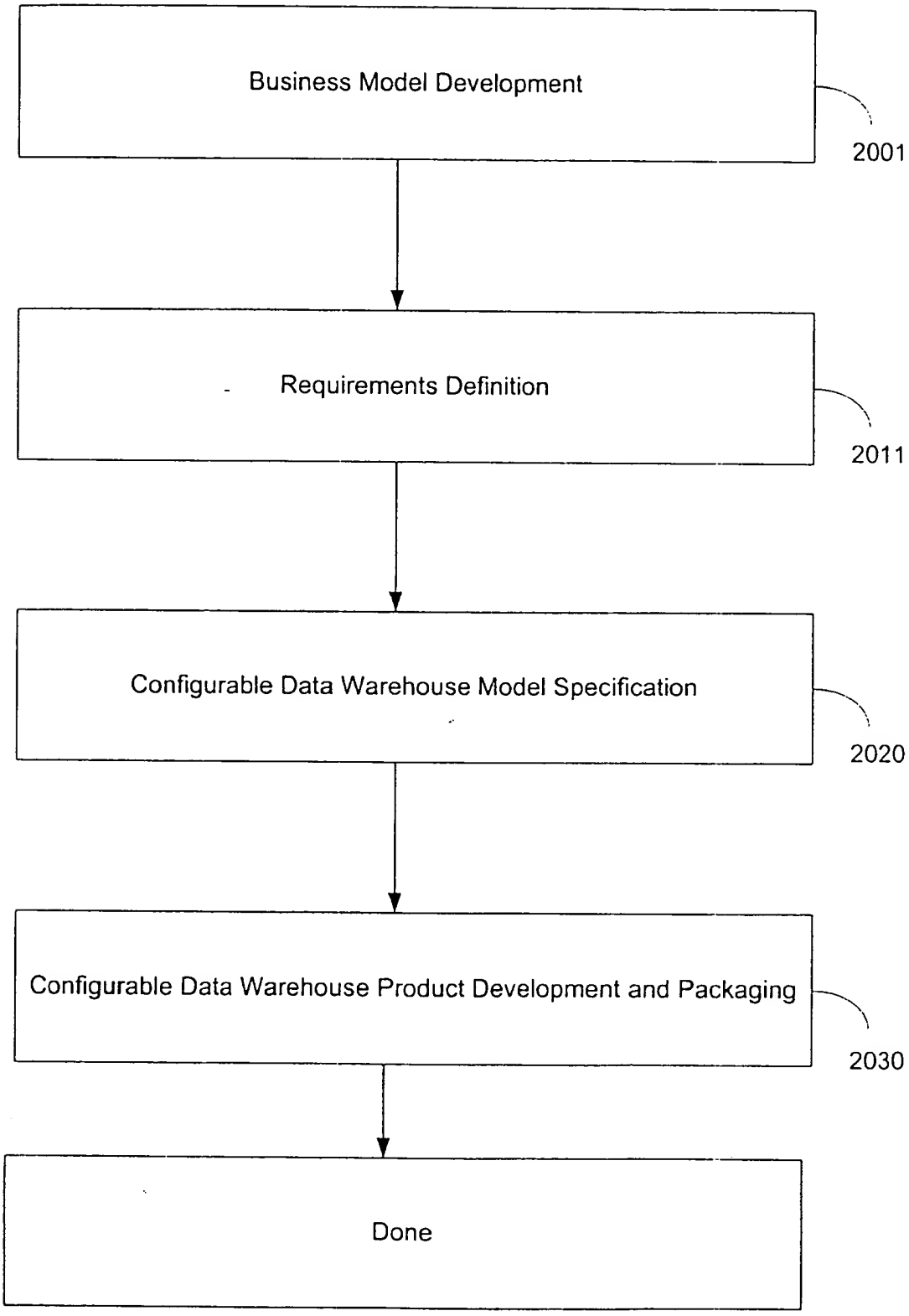

Business Model Development
2001
Requirements Definition
2011
Configurable Data Warehouse Model Specification
2020
Configurable Data Warehouse Product Development and Packaging
2030
Done

Figure 27A

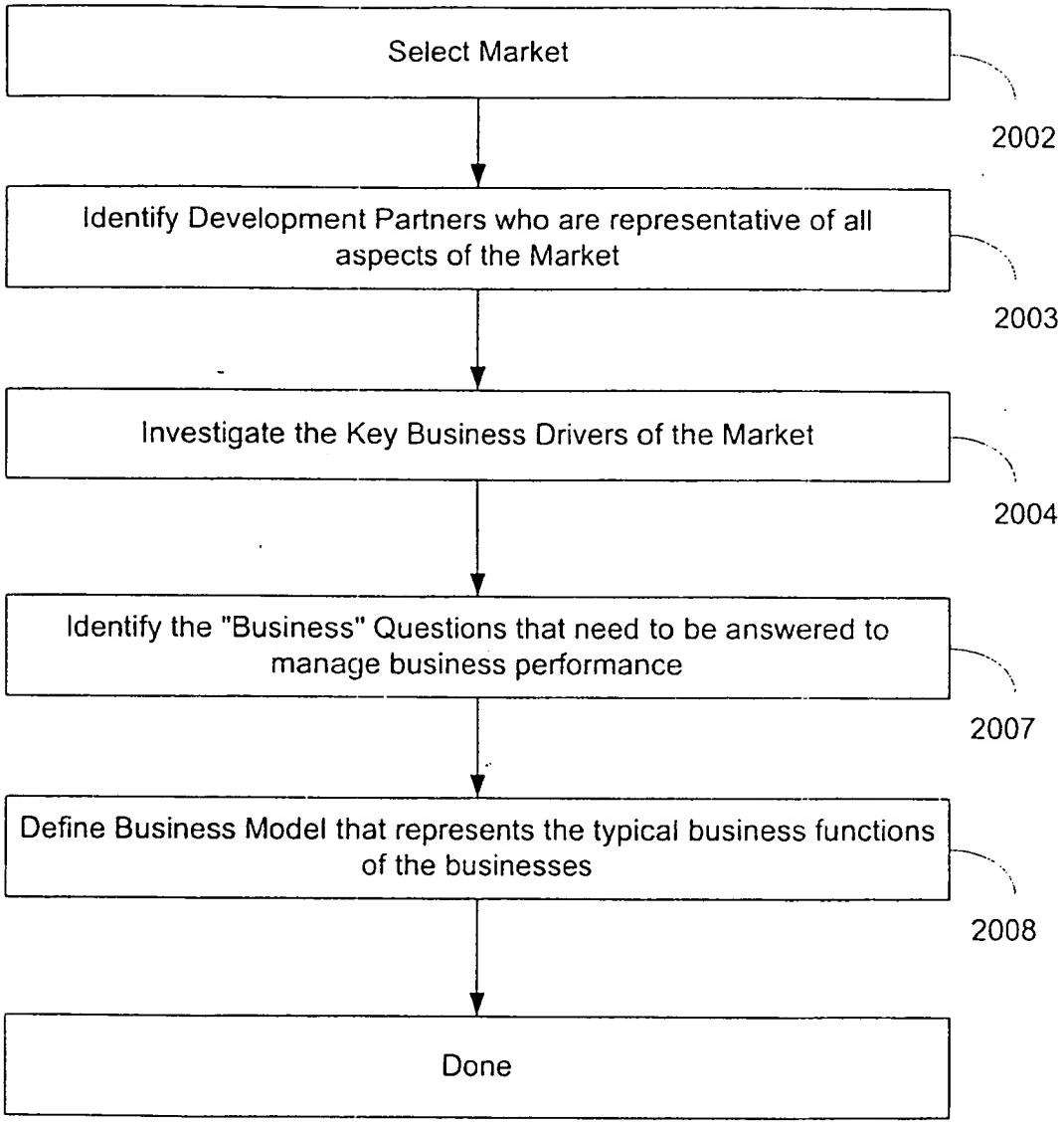

Select Market
2002
Identify Development Partners who are representative of all aspects of the Market
2003
Investigate the Key Business Drivers of the Market
2004
Identify the "Business" Questions that need to be answered to manage business performance
2007
Define Business Model that represents the typical business functions of the businesses
2008
Done

Figure 27B

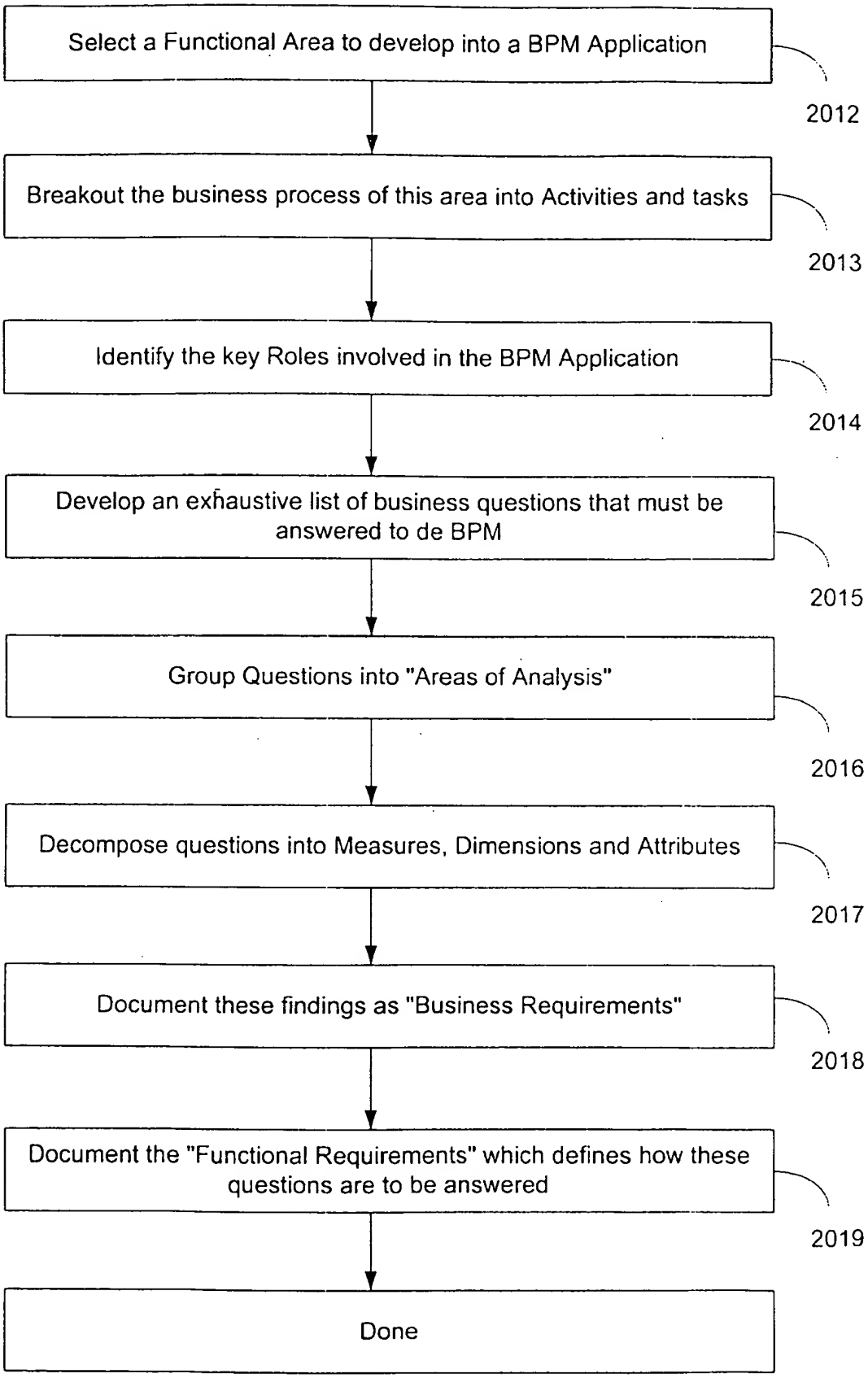

Select a Functional Area to develop into a BPM Application
2012
Breakout the business process of this area into Activities and tasks
2013
Identify the key Roles involved in the BPM Application
2014
Develop an exhaustive list of business questions that must be answered to de BPM
2015
Group Questions into "Areas of Analysis"
2016
Decompose questions into Measures, Dimensions and Attributes
2017
Document these findings as "Business Requirements"
2018
Document the "Functional Requirements" which defines how these questions are to be answered
2019
Done

Figure 27C

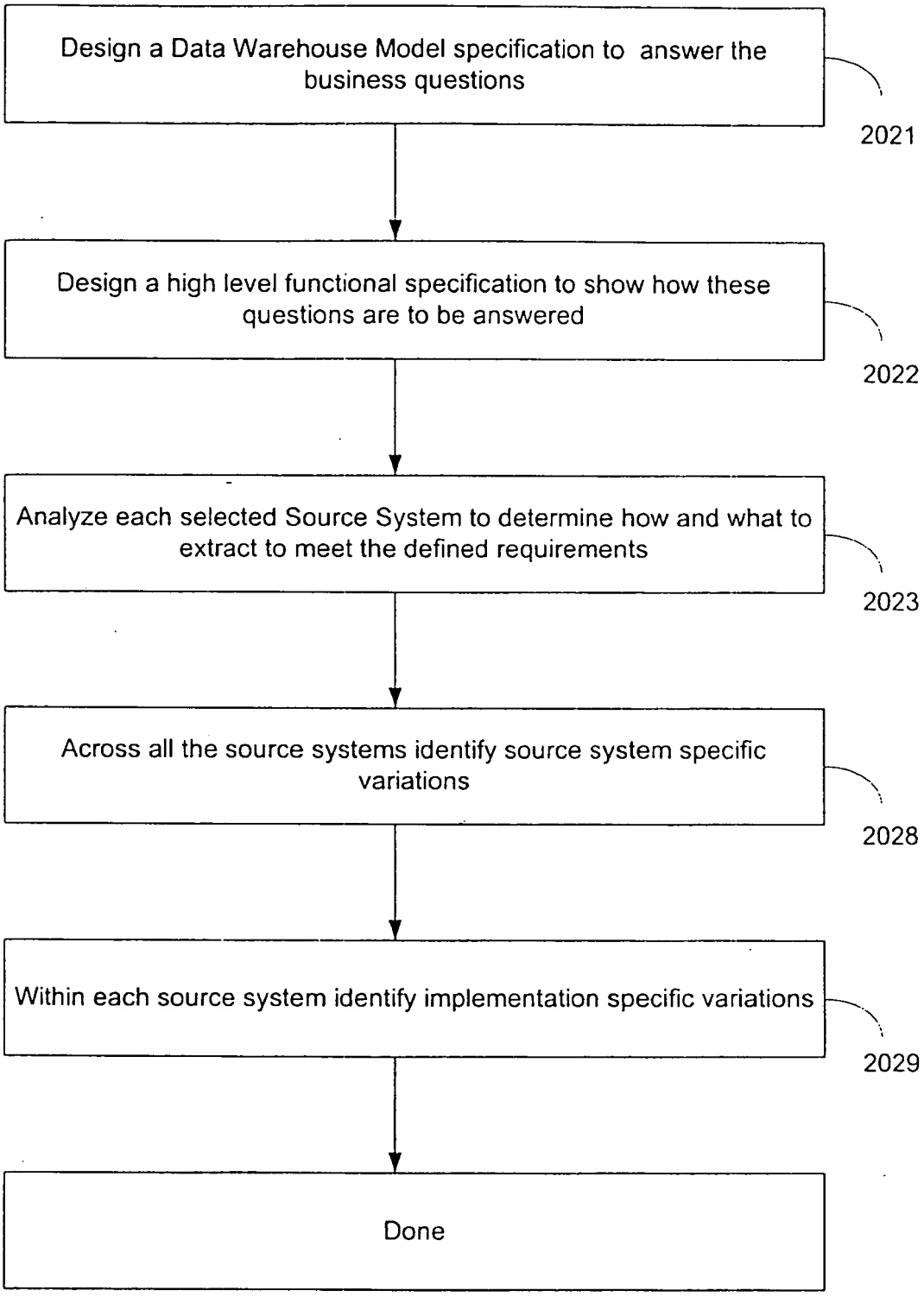

Design a Data Warehouse Model specification to answer the business questions
2021
Design a high level functional specification to show how these questions are to be answered
2022
Analyze each selected Source System to determine how and what to extract to meet the defined requirements
2023
Across all the source systems identify source system specific variations
2028
Within each source system identify implementation specific variations
2029
Done

Figure 27D

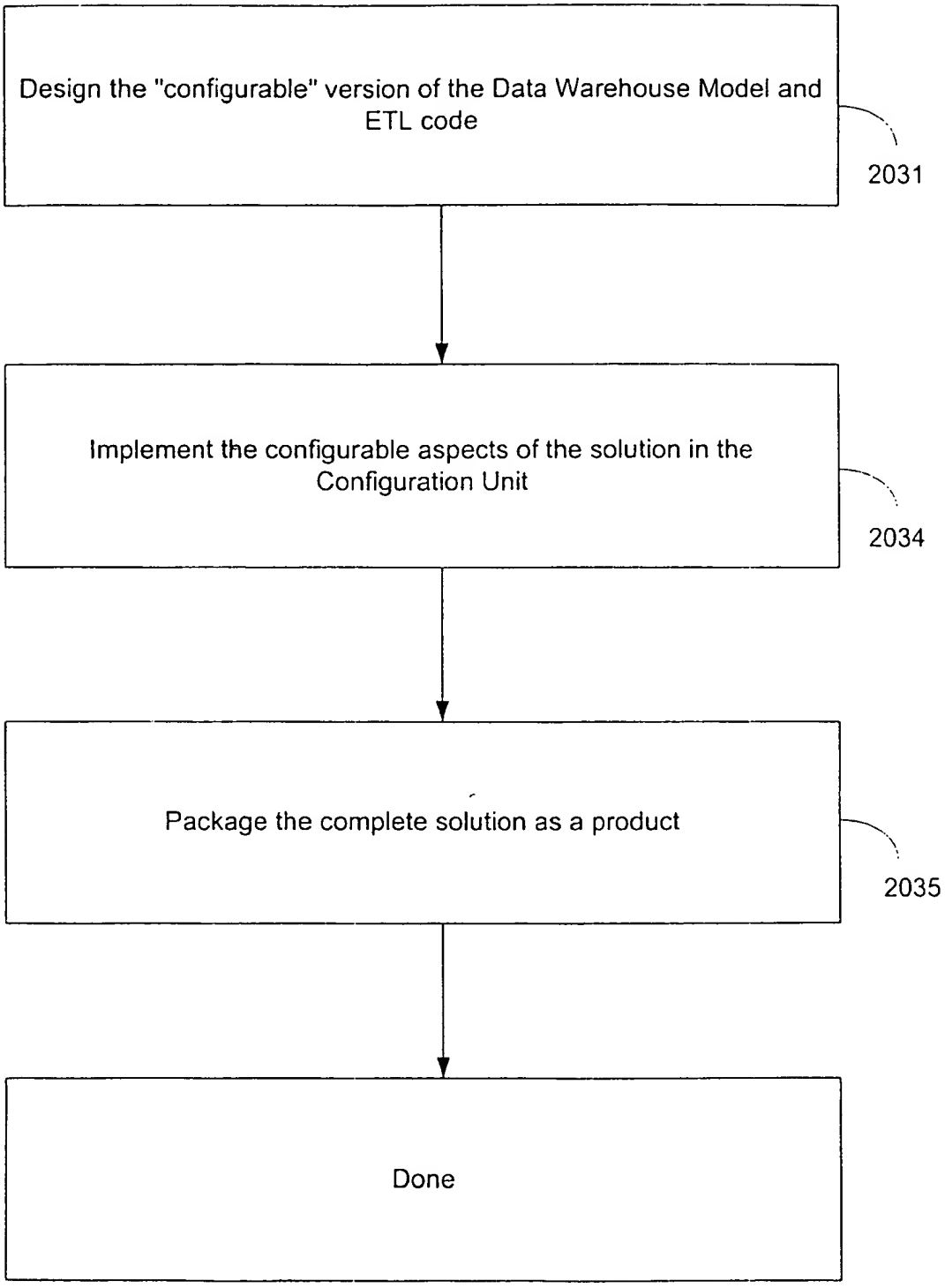
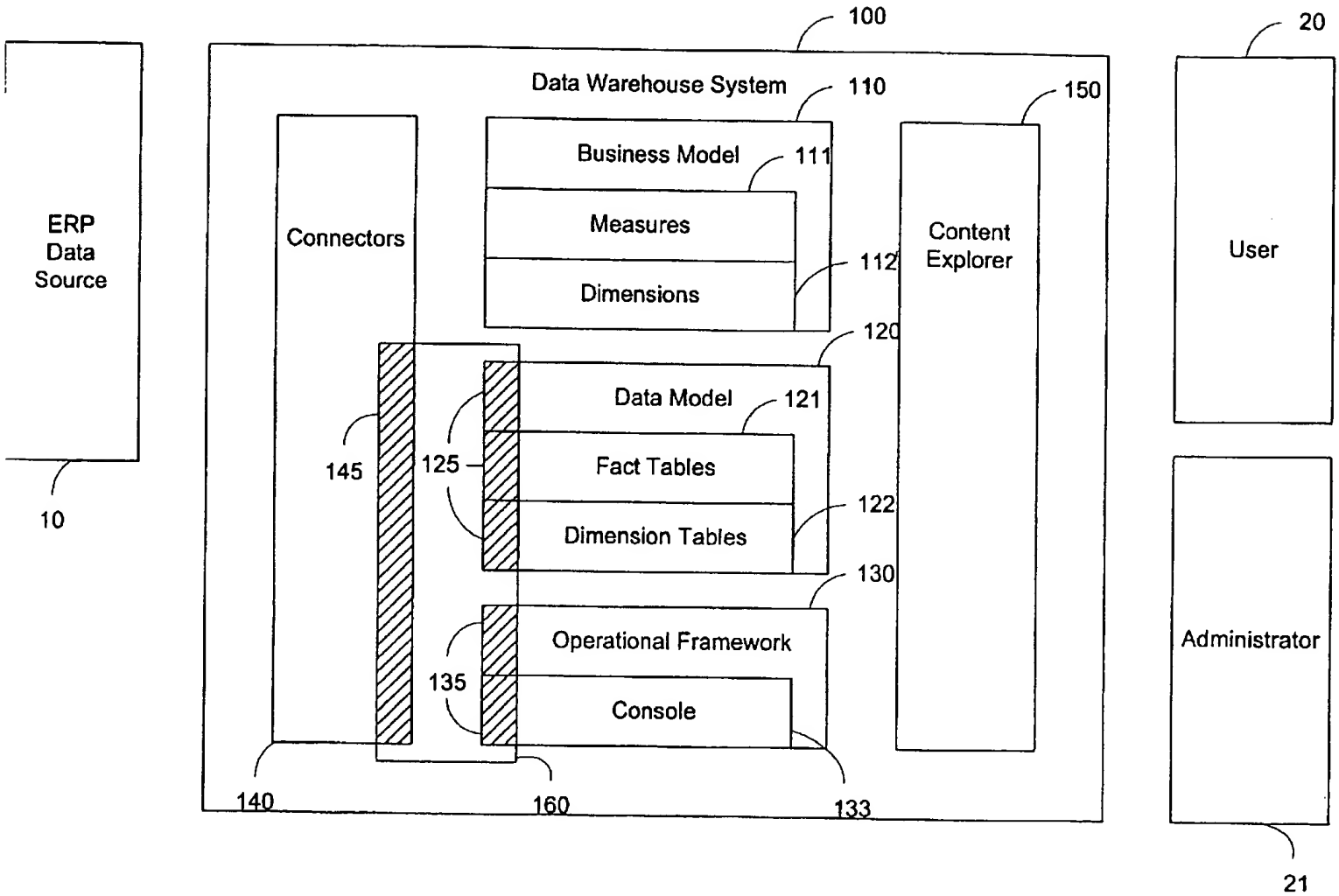

Design the "configurable" version of the Data Warehouse Model and ETL code
2031
Implement the configurable aspects of the solution in the Configuration Unit
2034
Package the complete solution as a product
2035
Done

Figure 27E


100
20
ERP
Data
Source
Data Warehouse System
110
150
Business Model
111
Connectors
Measures
Content
Explorer
User
112
Dimensions
120
Data Model
121
145
125
Fact Tables
122
Dimension Tables
130
Operational Framework
135
Console
Administrator
10
140
160
133
21